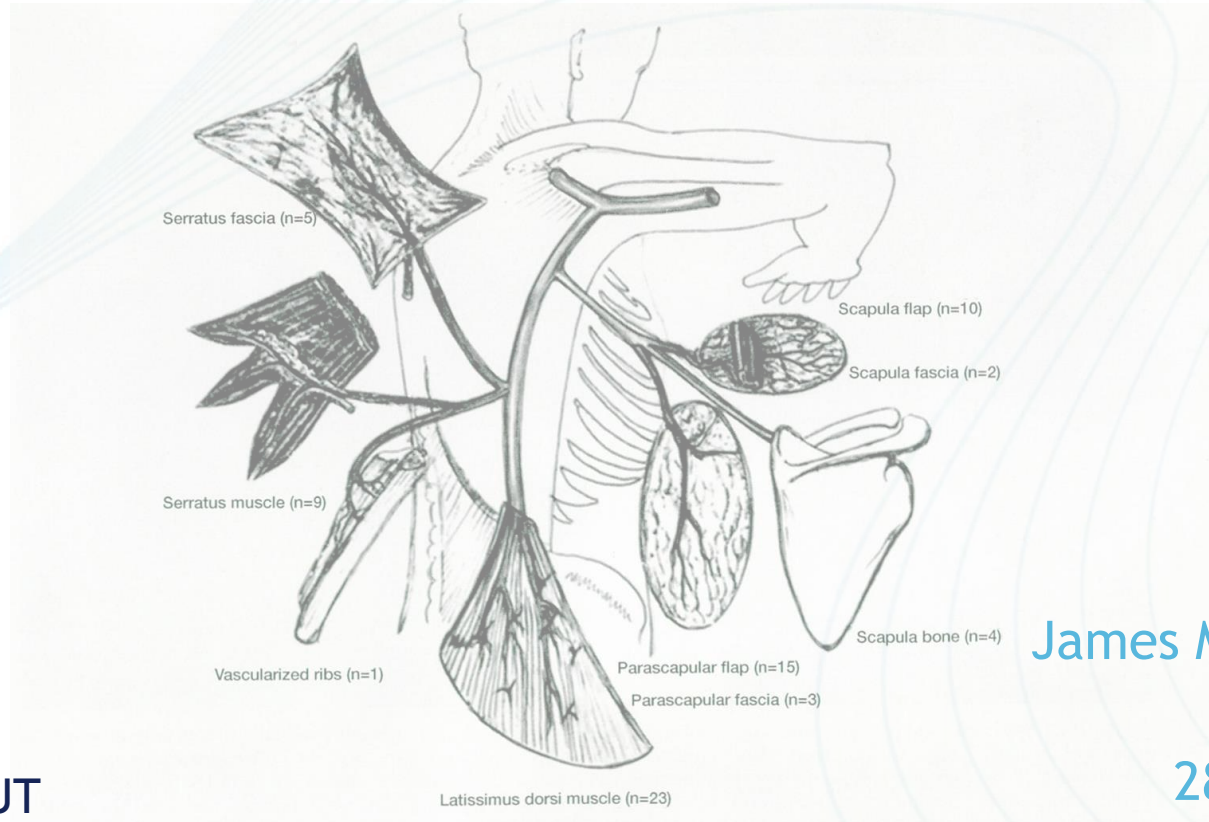


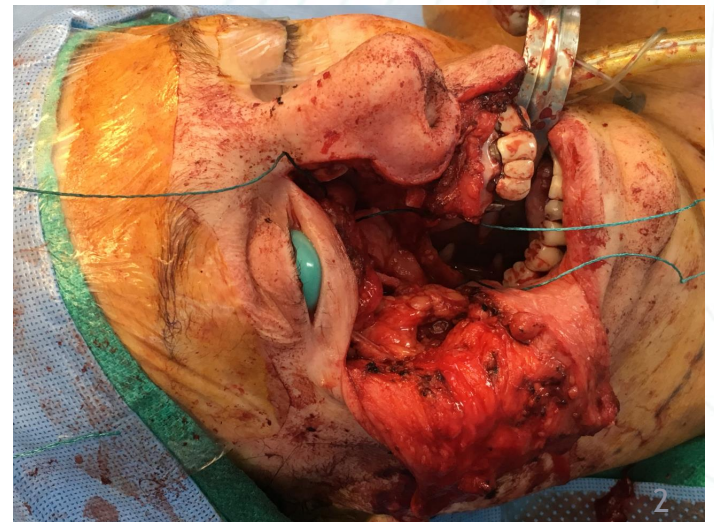
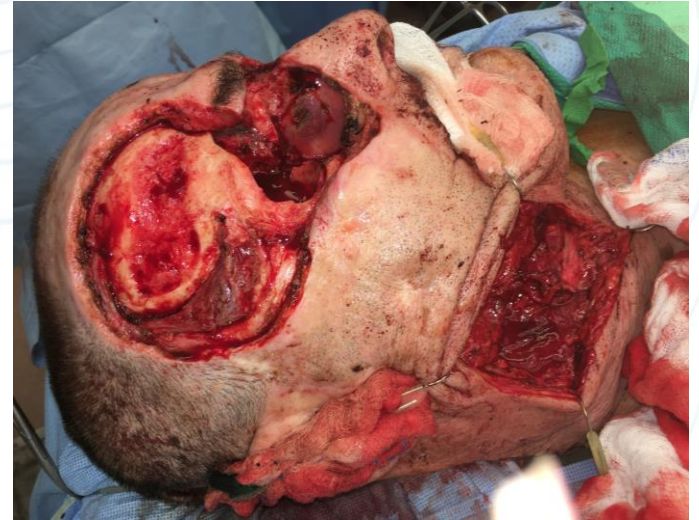
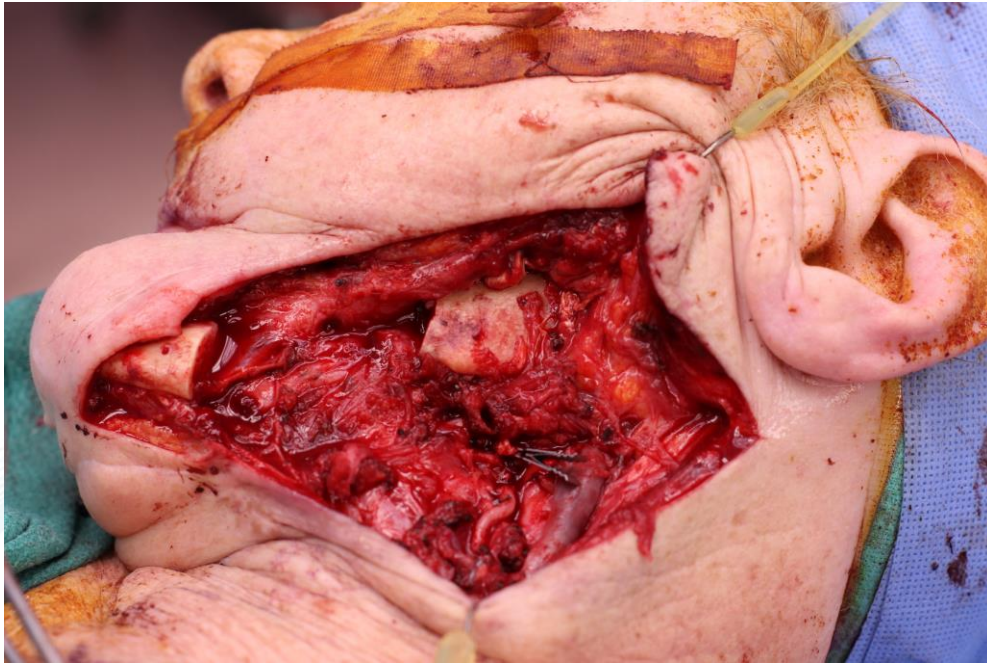
# The Subscapular System of Flaps in Head and Neck Reconstruction



James M. Hamilton  
PGY4

28 June 2017

# Head and Neck Reconstruction Goals





## Head and Neck Reconstruction Goals



# Head and Neck Reconstruction Goals

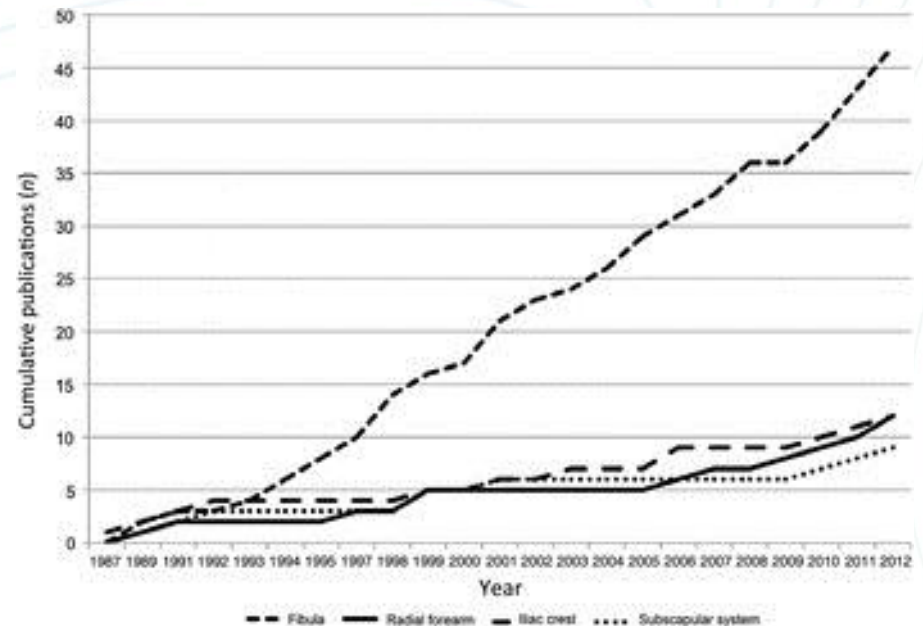
- Wide variety of donor sites:
  - Fibula
  - Iliac crest
  - Scapula
  - Forearm
  - Rectus
  - Latissimus dorsi
  - ALT
- Each has advantages and disadvantages





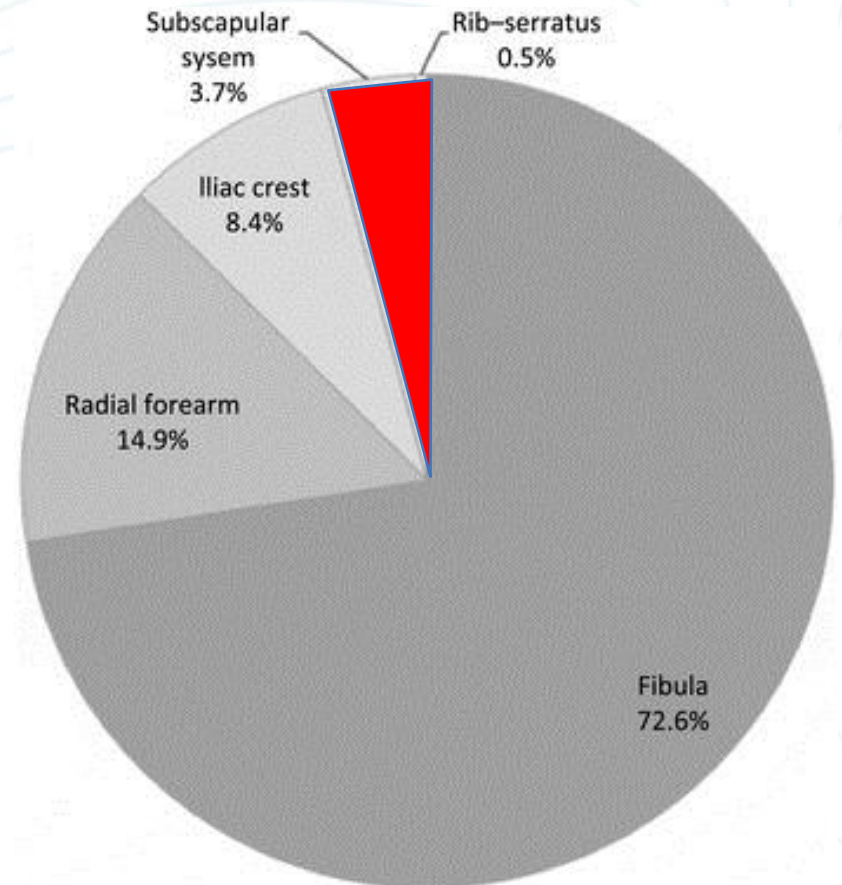
## Why are we talking about this?

- Fibular and anterolateral thigh flaps have become increasingly popular
- Shortcomings of scapular donor site led to decreased use
  - Longer op time
  - Repositioning
  - Precludes 2 team approach
  - Presumed reduction in morbidity



## Why are we talking about this?

- Osteocutaneous free flaps use
  - Fibula flaps used 73%
  - Subscapular flaps used less than 5% of the time



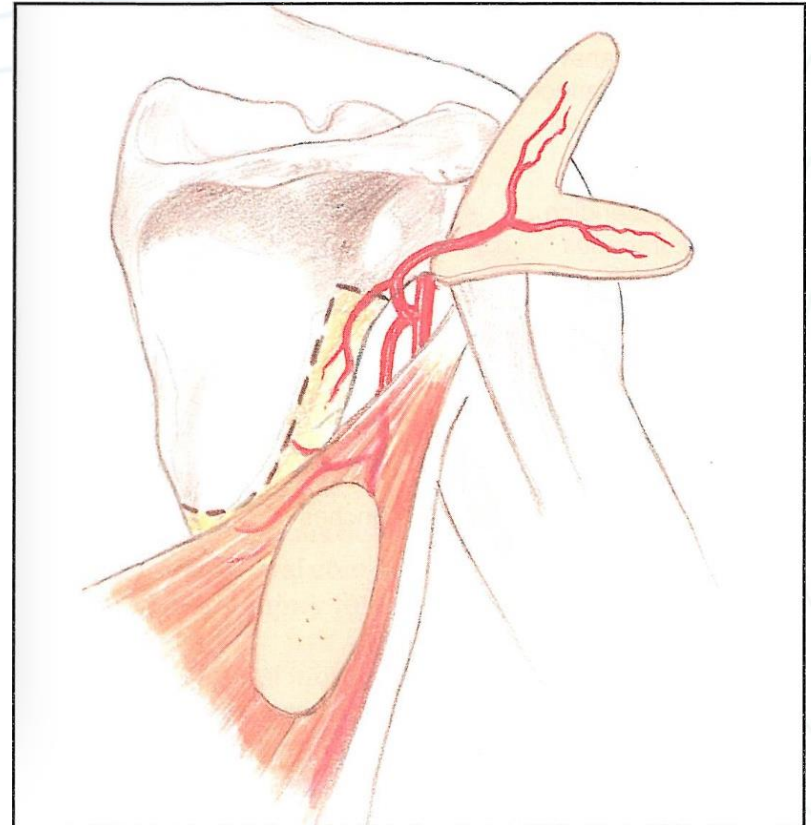
## Why are we talking about this?

- Osteocutaneous FFF and myocutaneous ALT remain the workhorses and often first choices for reconstruction of defects in the head and neck requiring soft tissue and bony elements respectively due to their ease and dependability, less time
- Subscapular system has features that make its use extremely advantageous in some circumstances



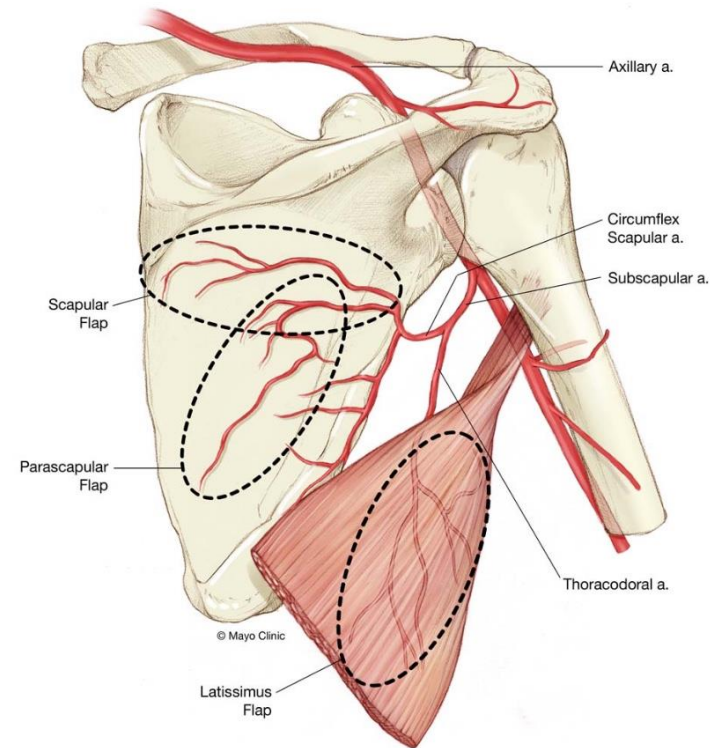
# Subscapular System

- Lateral thoracic flap based on the lateral thoracic artery
  - Baudet (1976) Bordeaux, France
  - Variable anatomy
  - Paved the way for the emergence of the system based on the subscapular arterial system



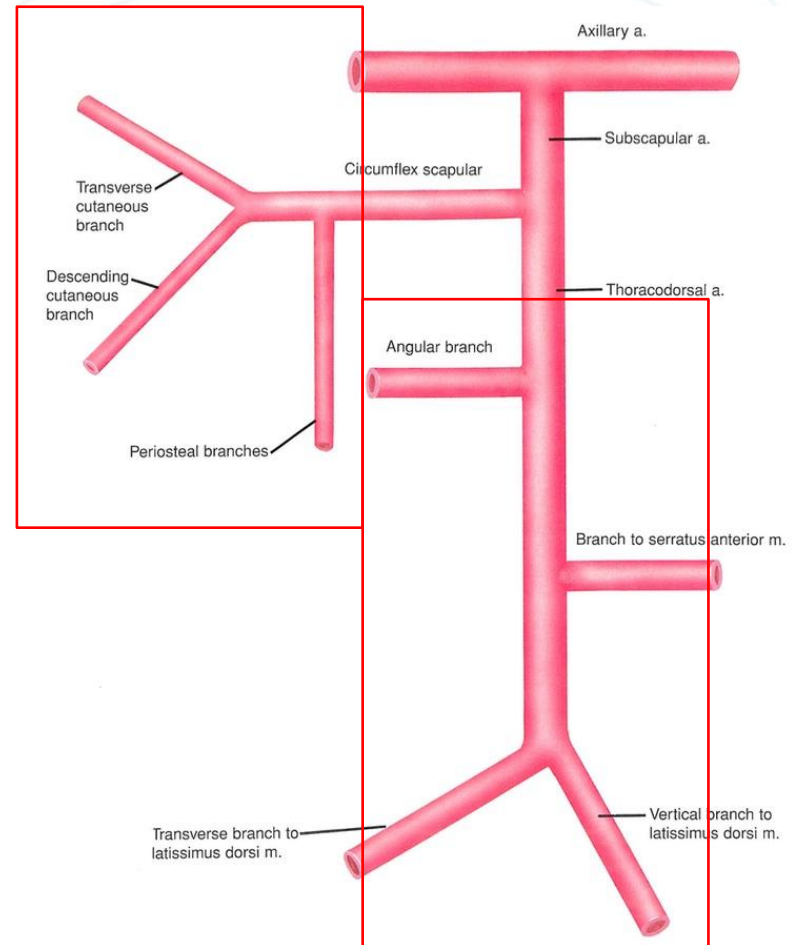
# Subscapular System

- Unique among free tissue donor sites for H&N recon
  - Diversity of tissue type
  - Large surface area
  - Mobility of various flaps relative to each other
  - Long length and caliber of vascular pedicle



# Subscapular System

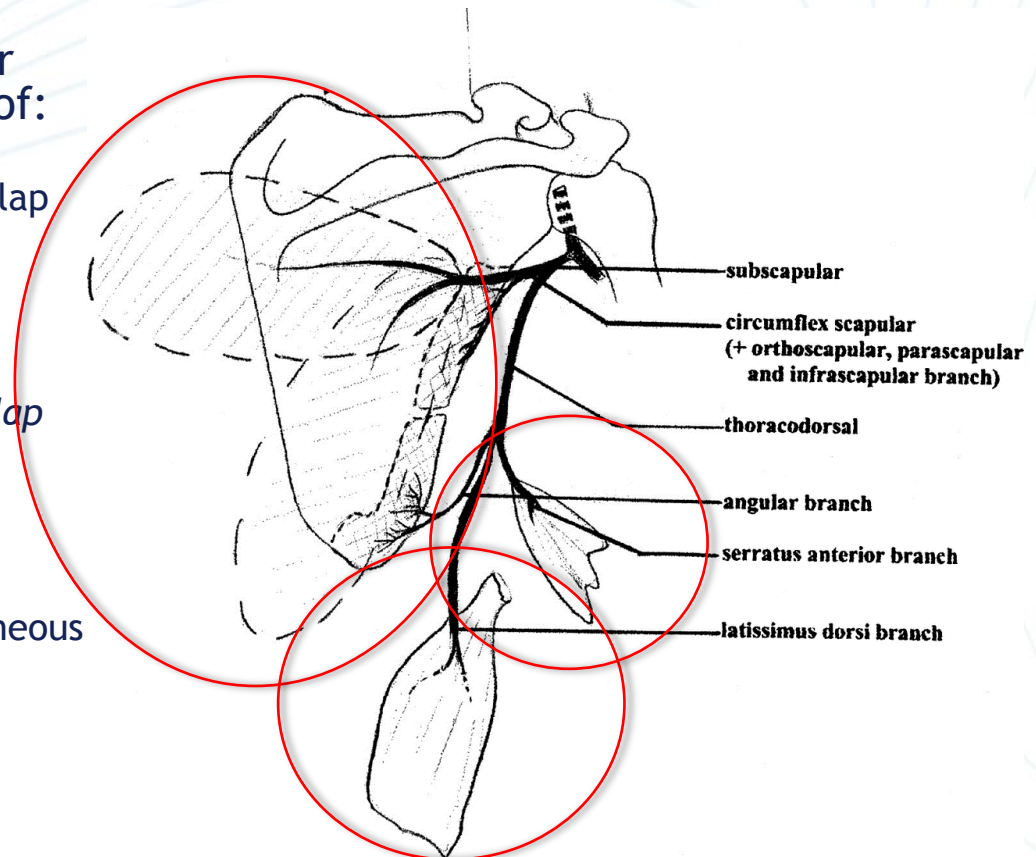
- Anatomy of subscapular arterial system is key to understanding range
- Subscapular a. branches into:
  - circumflex scapular
  - thoracodorsal a.





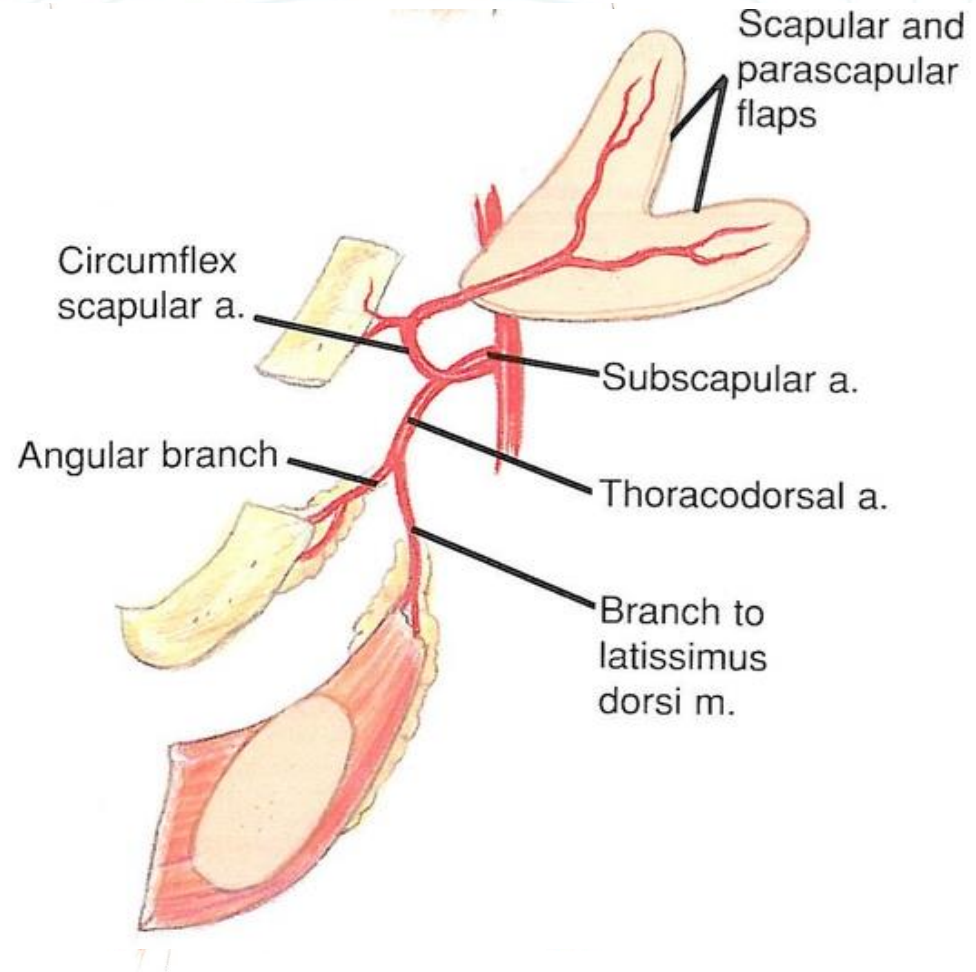
# Subscapular System

- Branching pattern of subscapular artery and vein permit transfer of:
  - Scapular fasciocutaneous flap
  - Parascapular fasciocutaneous flap
  - Scapular-parascapular osteofasciocutaneous flap
  - *Latissimus dorsi* flap
  - *Lat. Dorsi musculocutaneous flap*
  - *Lat. Dorsi Rib osteomusculocutaneous flap*
  - Serratus anterior flap
  - Serratus anterior musculocutaneous flap
  - Serratus anterior rib flap
  - Chimeric flaps



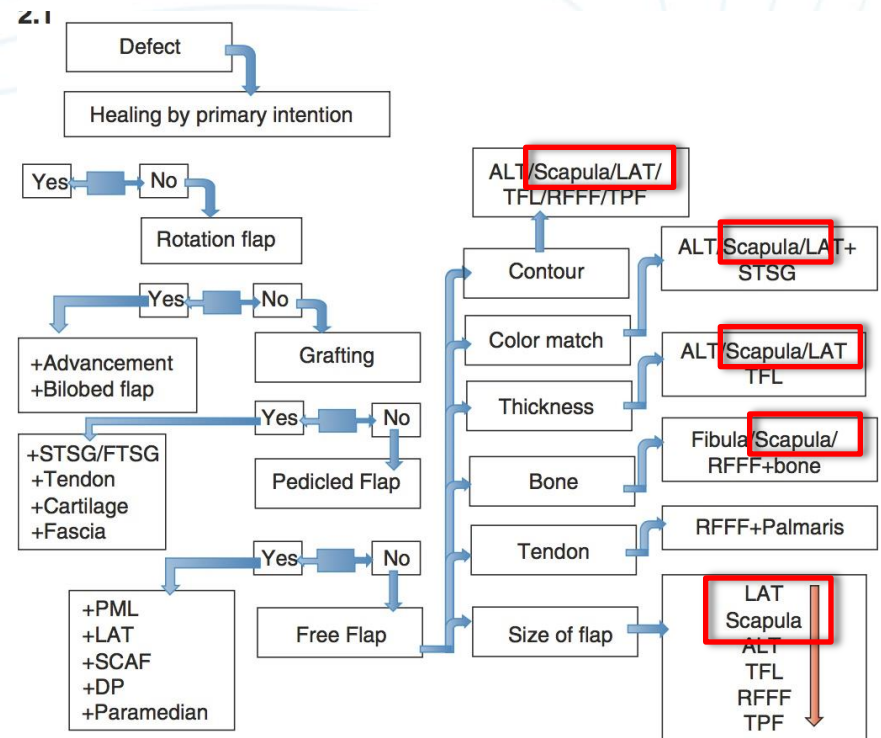
## Head and Neck Reconstruction Goals

- Wide array of hard and soft tissue components
- Simultaneous transfer of up to 5 tissue islands



# Head and Neck Reconstruction Goals

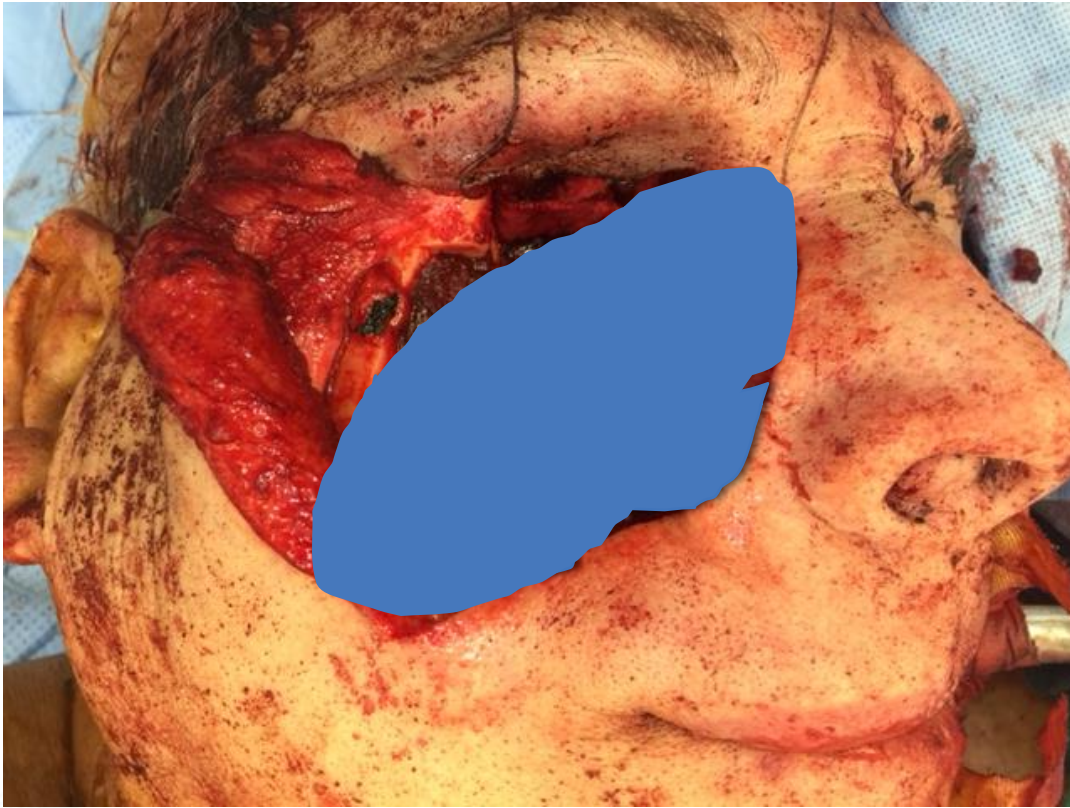
- Flap selection
  - Patient factors
    - Performance status
    - Comorbidities
    - Preference and expectations
    - Occupation/Activities
  - Recipient site
    - Shape/dimensions of defect
    - Tissues to be replaced
  - Donor Site
    - Anatomy
    - Vascular disease
    - Prior surgery/trauma/cutaneous lesions
  - Surgeon familiarity







Case #2

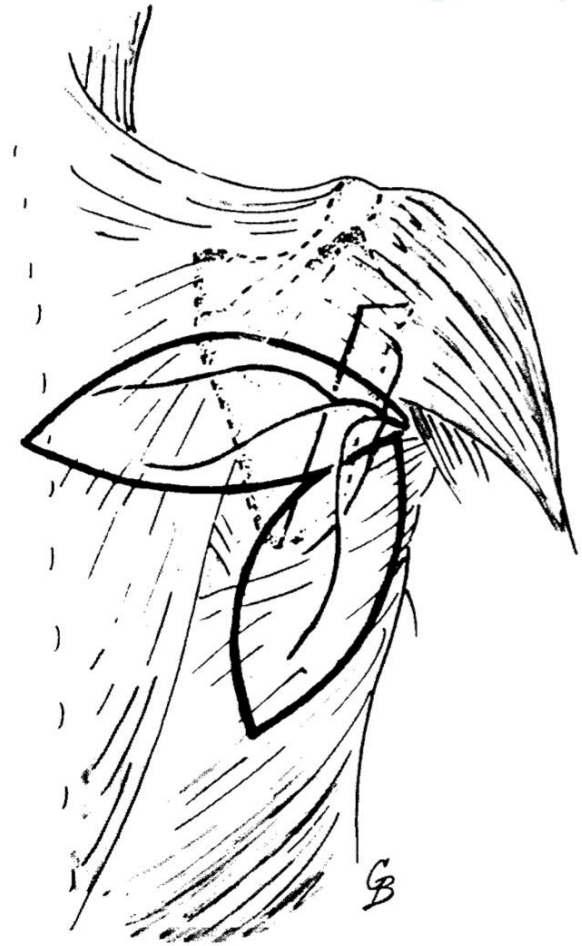
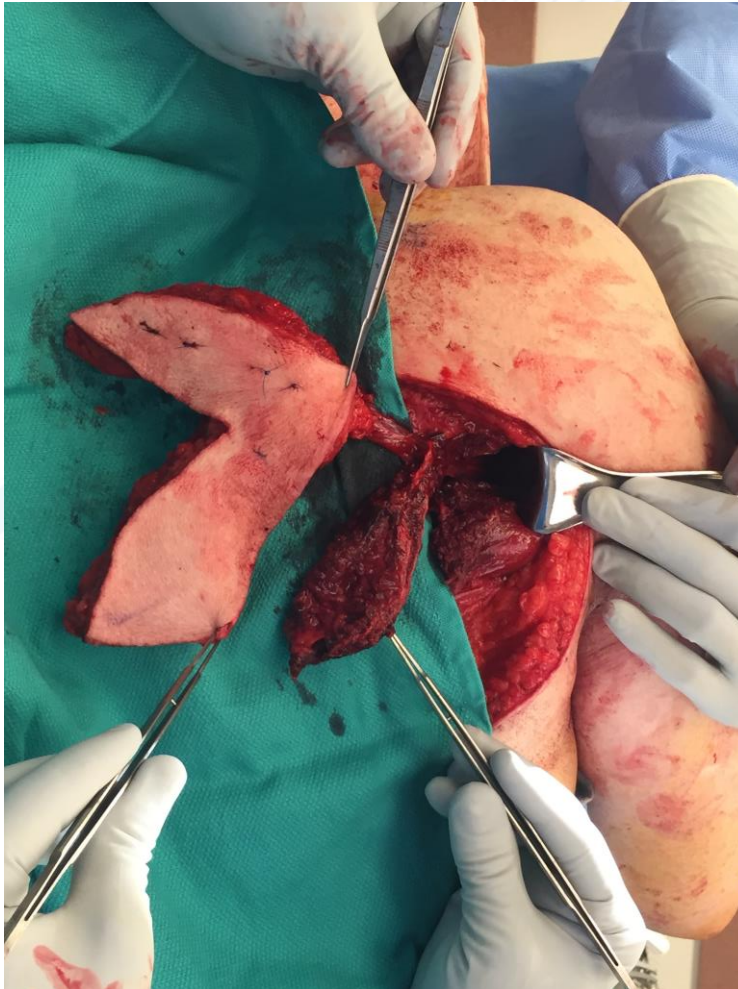


- oral mucosa/hard palate
- nasal wall
- vertical and horizontal buttresses
- malar and orbital skin

**Best flap for the job?**



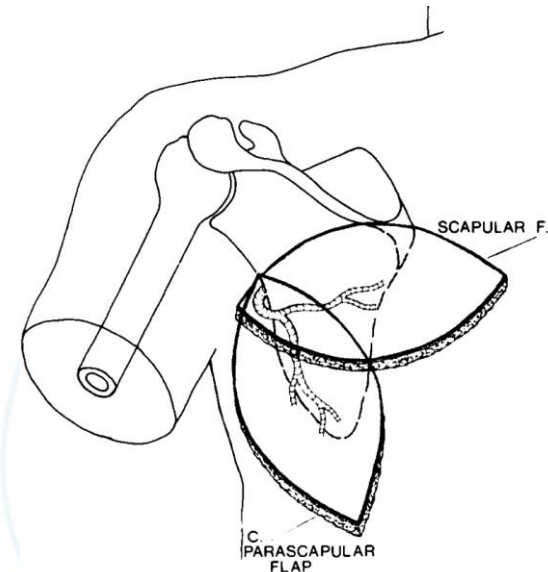
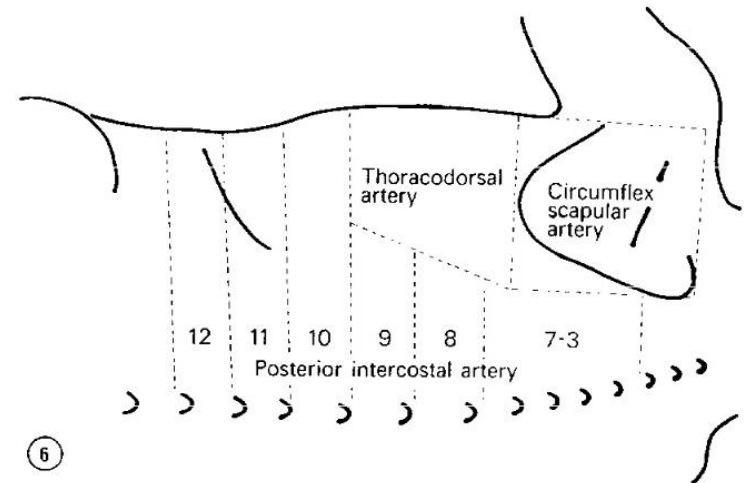
## Scapular/Parascapular Flaps





# History

- Saijo (1978) Kanagawa, Japan
  - dye injection studies
  - “2 potential musculocutaneous flaps based respectively on circumflex scap and thoracodorsal vessels”
- Dos Santos (1980) Brazil
  - First microsurgical scapular flap
- Nassif (1982) Bordeaux, France
  - parascapular flap
    - fasciocutaneous flap with vertical skin paddle over lateral scapular border
  - expanded the dimensions of the cutaneous territory of the CSA



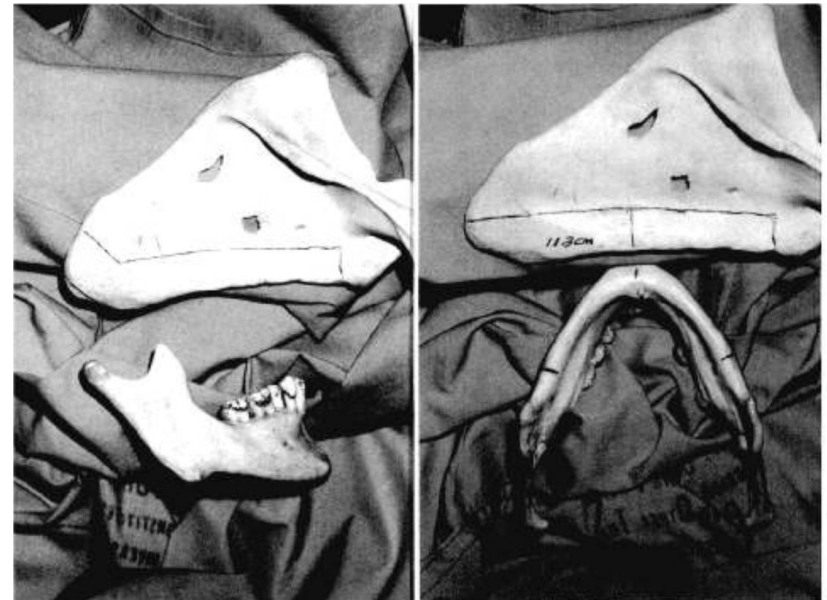
# History

- Gilbert and Teot (1982) France
  - First series osteocutaneous flaps
- Swartz (1986) Pittsburgh, PA
  - 26 pts with complex maxillary and mandibular defects
  - Single stage recon with bone from lateral scapula
  - No flap failures reported
  - Only 2 pts w donor site complications

## The Osteocutaneous Scapular Flap for Mandibular and Maxillary Reconstruction

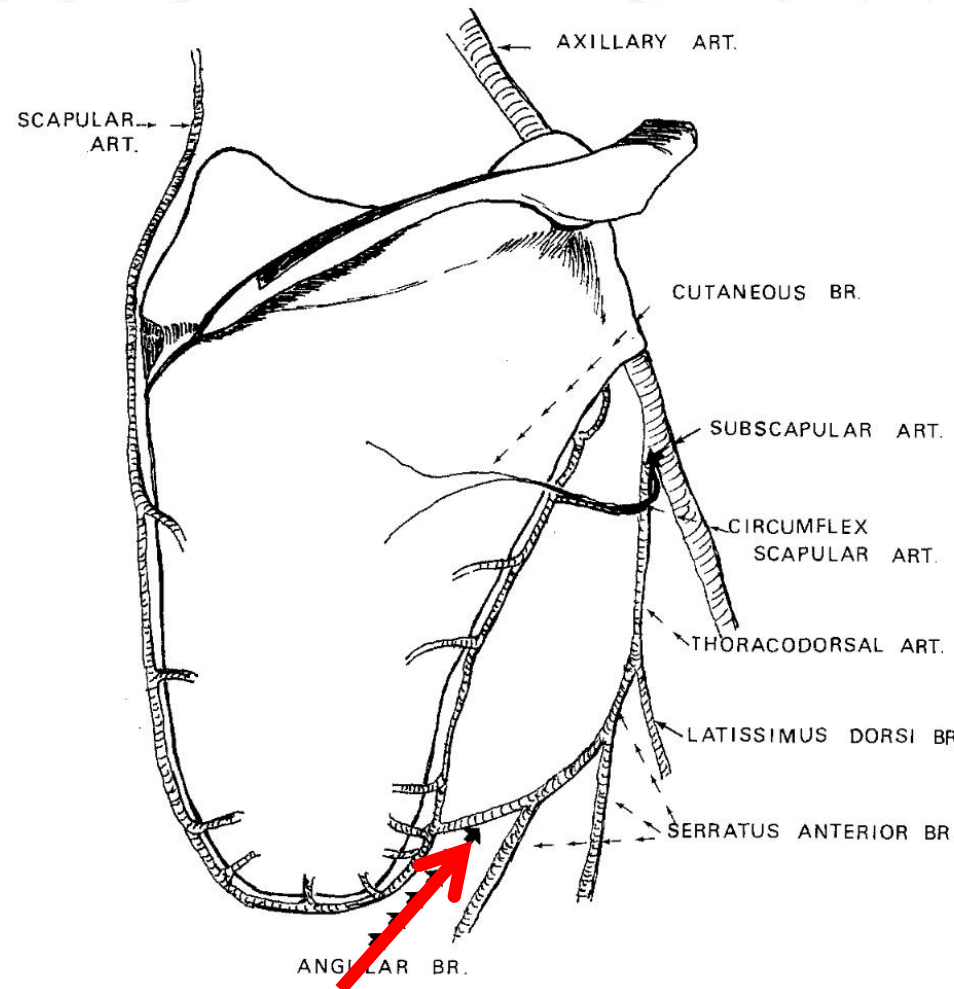
William M. Swartz, M.D., Joseph C. Banis, M.D., E. Douglas Newton, M.D., Sai S. Ramasastry, M.D., Neil F. Jones, M.D., and Robert Acland, M.D.

Pittsburgh, Pa.



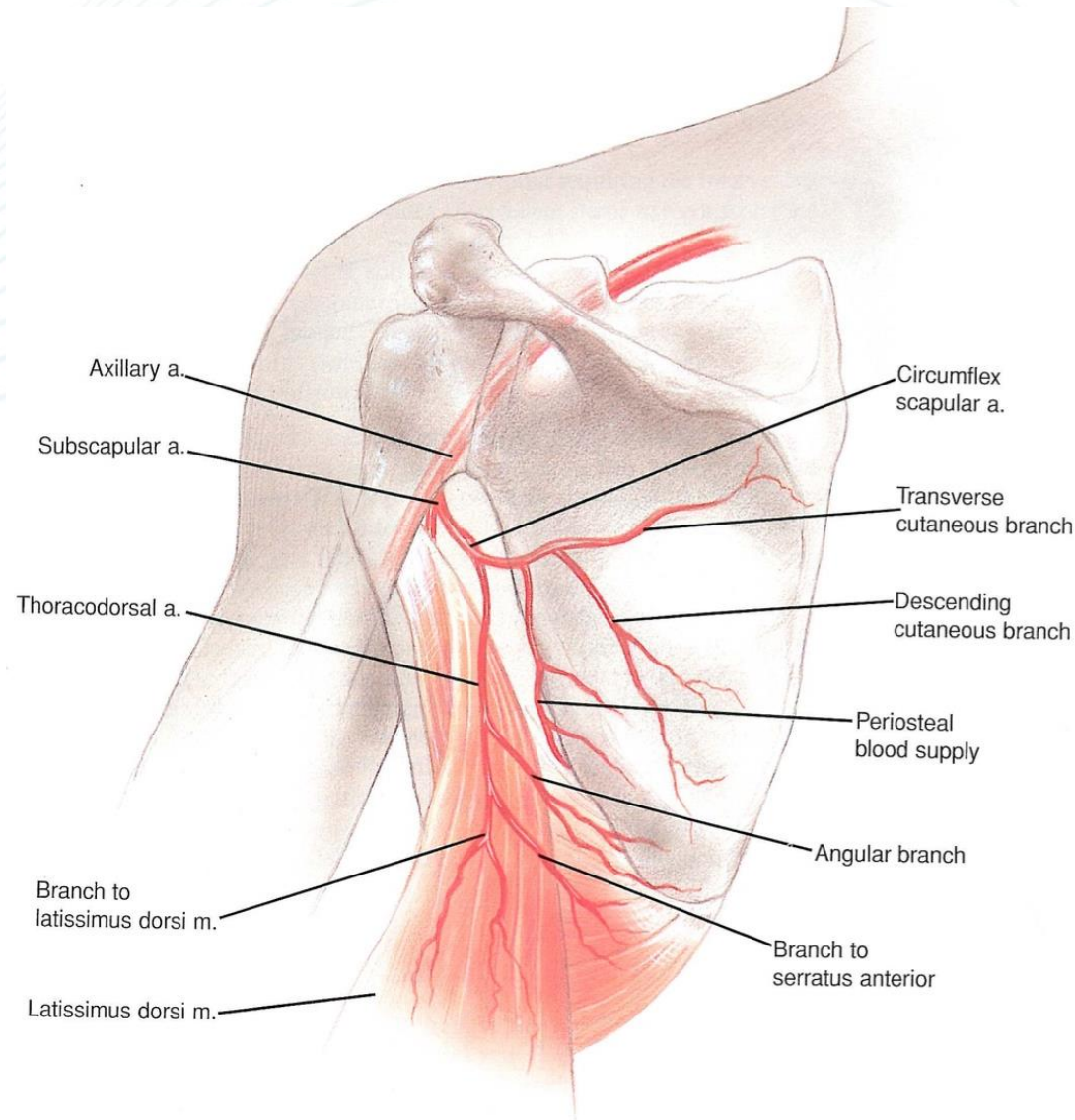
# History

- Deraemaecker (1988)  
Belgium
  - angular artery: independent blood supply to the scapular tip from thoracodorsal a.
- Coleman and Sultan (1991)
  - Independent harvest lateral border and scapular tip
    - Enhanced mandibular recon
    - Expanded indications to orbital and maxillary defects



## Relevant Anatomy

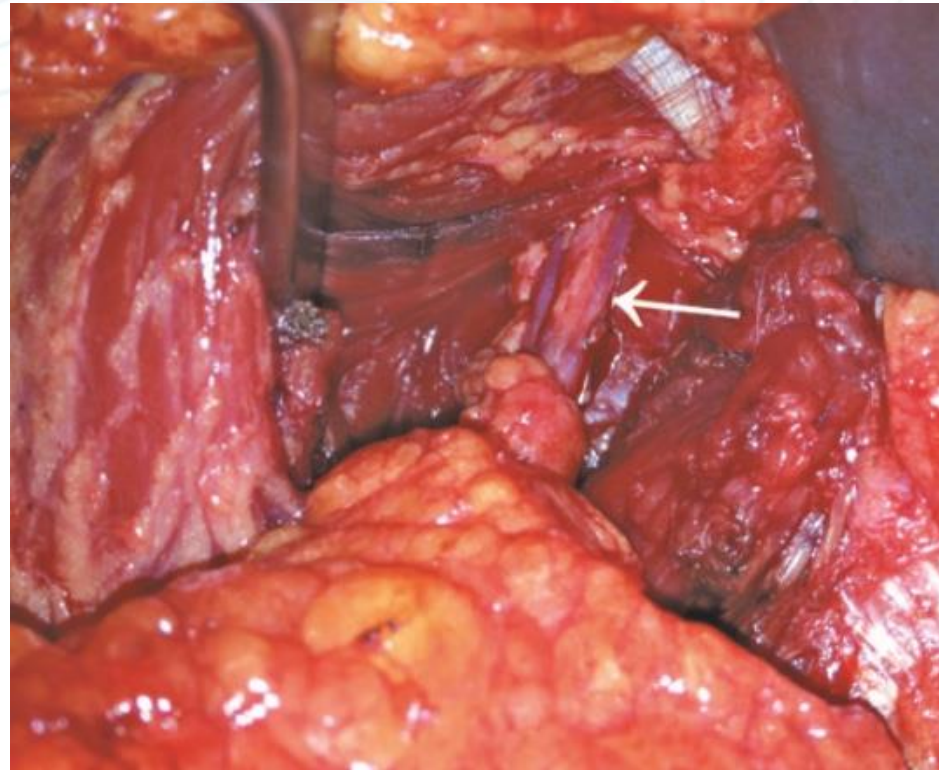
- Subscapular artery
  - Branch of axillary a.
  - 2-3 cm in length
- Circumflex Scapular artery
  - Periosteal branches to lateral scapula
  - Transverse (Horizontal) branch
  - Descending (Vertical) Branch
  - Branches directly from axillary a in 8-10%
- Angular Artery
  - Branch of thoracodorsal





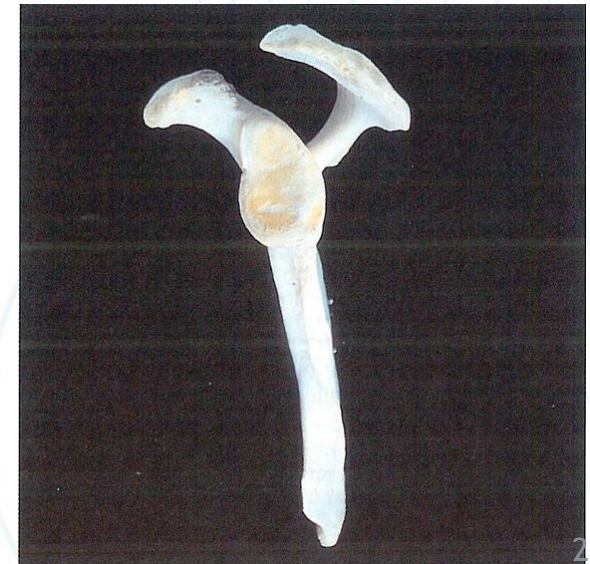
## Relevant Anatomy

- CSA accompanied by 2 venae comitantes
  - Merge into one vein before flowing into subscapular v.
- No motor nerves in scapular flap
  - Sensory innervation by lateral and posterior intercostals
  - No reported successful cases of sensate flap



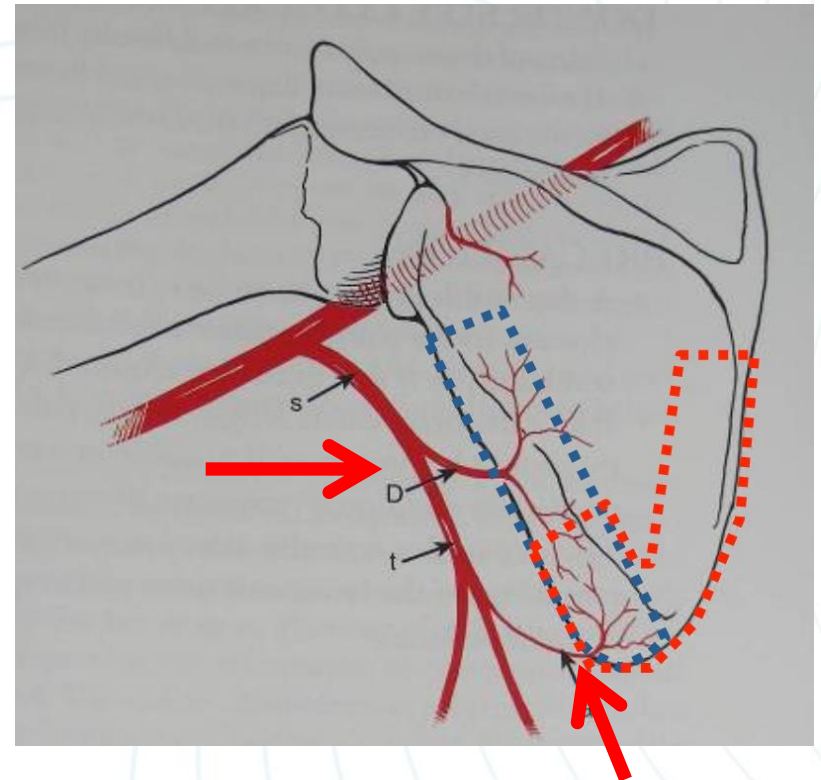
## Relevant Anatomy

- Scapula
  - Lateral border
    - thick, straight, bicortical
  - 10-14 cm may be harvested
  - Limited in cephalad extent by glenohumeral joint
  - Supplied by periosteal branches of CSA
- Tip
  - Bony triangle useful for reconstruction of orbital floor and palate
  - Supplied by the angular artery



## Relevant Anatomy

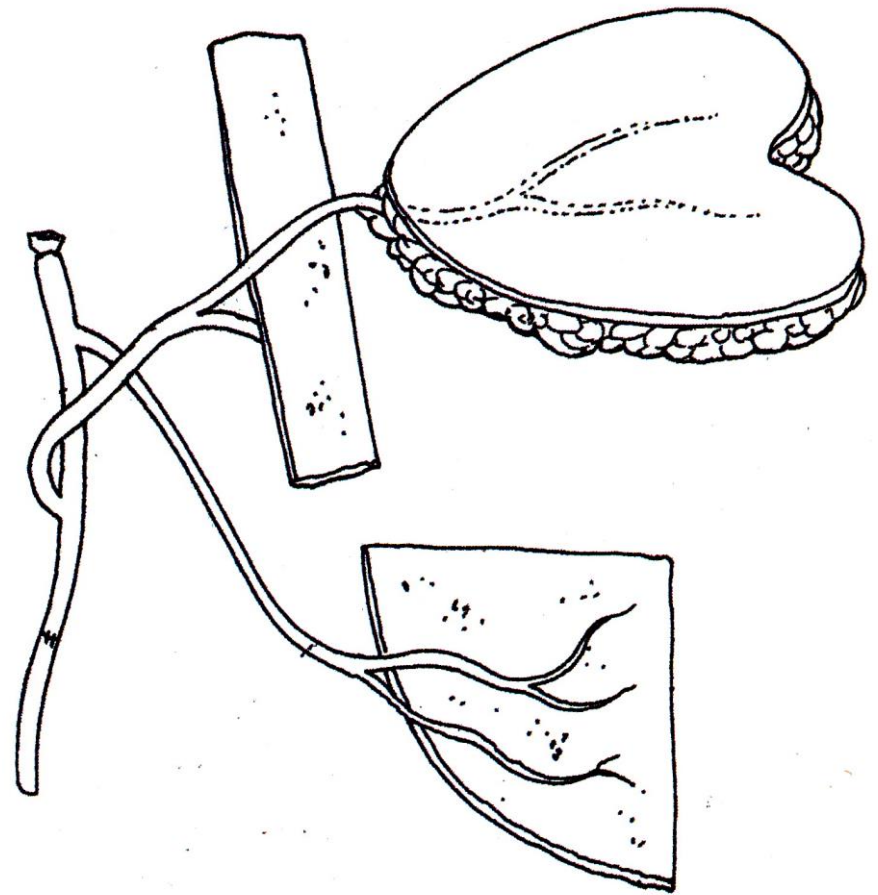
- Vascular Anatomy to the Scapula
  - Subscapular artery (s)
  - Circumflex Scapular A. (D)
  - Thoracodorsal A (t)
  - Angular A (a)





## Relevant Anatomy

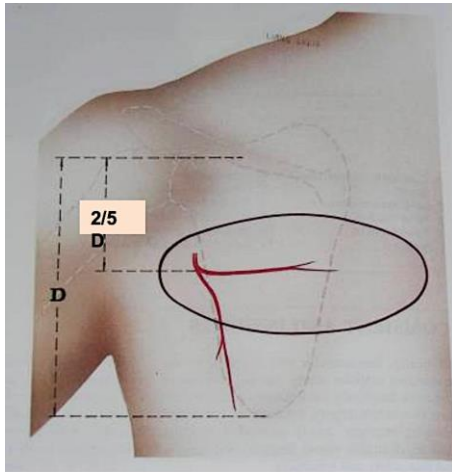
- Separate blood supply allows:
  - Osteotomies
  - Independent reconstruction of 2 bone defects
  - Tip to be transferred alone
  - Maximal separation of bone and soft tissues



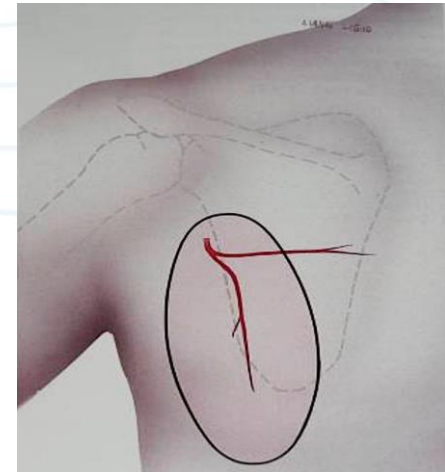
D



# Standard Flap Design

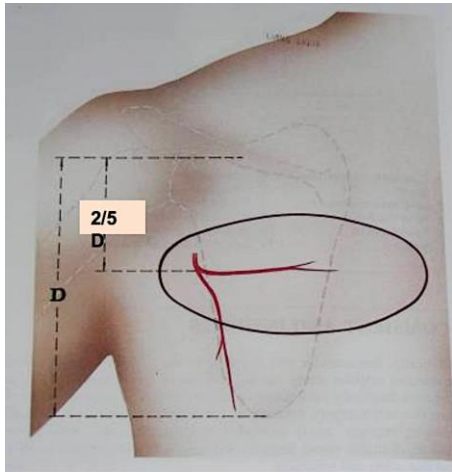


- **Scapular Flap**
  - Skin island:
    - Superior Limit: Spine of Scapula
    - Inferior Limit: Tip of Scapula
    - Medial Limit: Midline
    - Lateral extent-Post. Axillary Line
  - 18-20 cm x 7-8 cm
    - 8-9 cm x 8 cm to close primarily

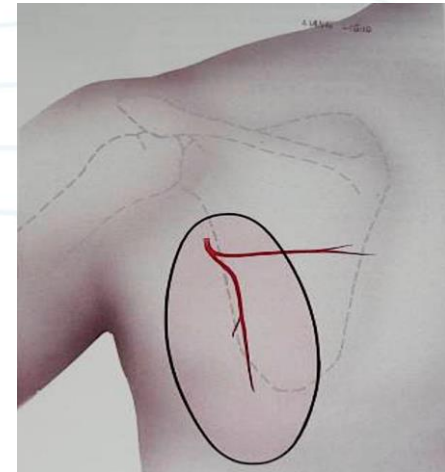


- **Parascapular Flap**
  - Skin island:
    - Superior Limit - Triangular Space
    - - Inferior Limit - up to 30 cm in length
    - - Width - up to 16 cm
  - 6-32 cm x 8-16 cm
    - ~10 cm to close primarily

# Standard Flap Design

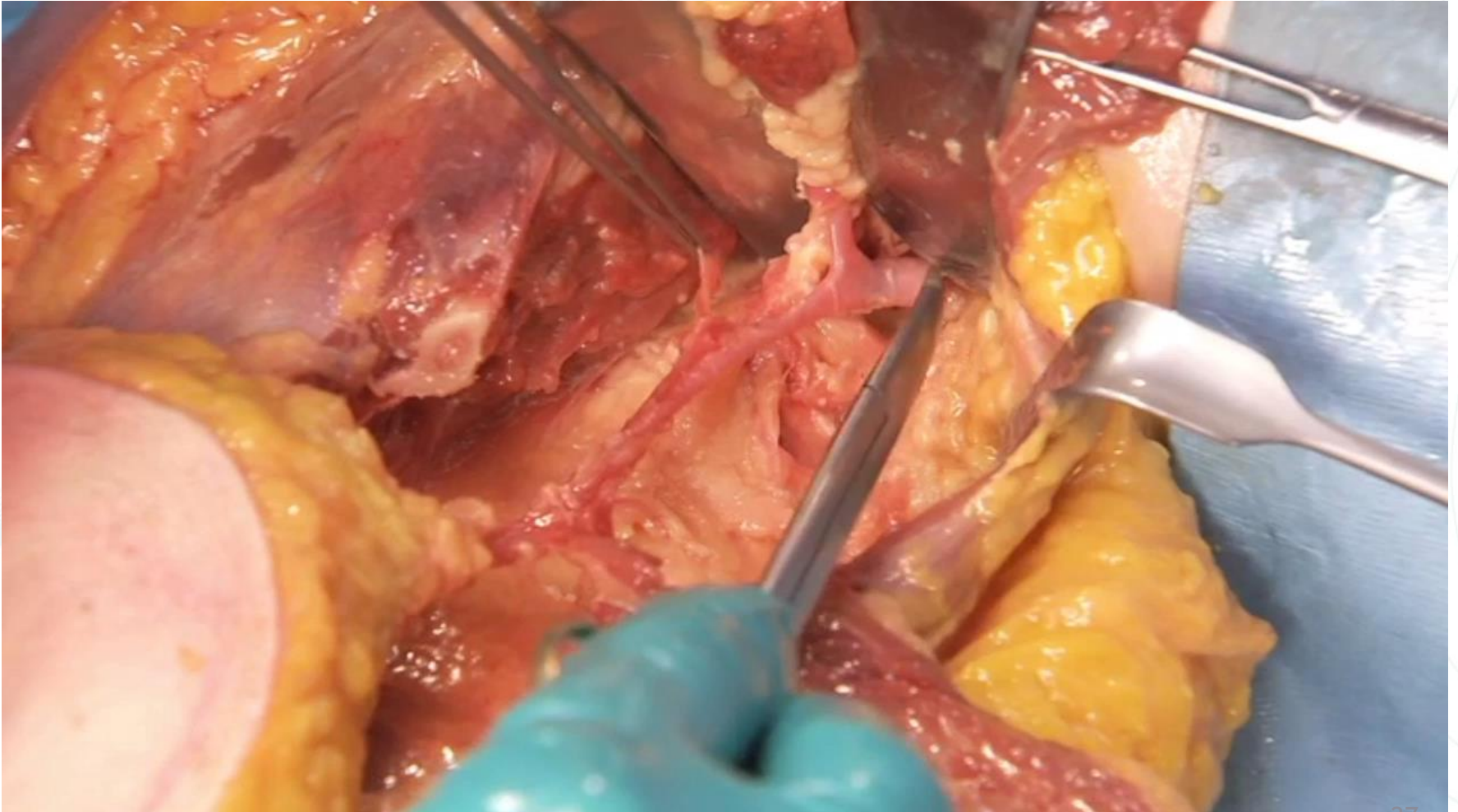


- Scapular Flap
  - Pedicle:
    - Horizontal branch of superficial CSA
    - Length: 7-10cm
    - Diameter: 1.2 mm (range 0.8-1.4 mm)



- Parascapular Flap
  - Pedicle:
    - Vertical branch of superficial CSA
    - Length: 10-20 cm
    - Diameter: 1.2 mm (range 0.8-1.4 mm)

## Flap Harvest



# Flap Planning

- Advantages- *defect* oriented
  - Large volume
    - Fills dead space
      - Avoids crust formation, infection, fistulae
    - Adds bulk, contour
  - Multiple tissue components
  - Independence
    - Degrees of freedom
  - Shape
    - Scapular tip
      - Morphologic similarity to hard palate and orbital floor



# Flap Planning

- Indications - *patient* oriented
  - **PVD**
    - Precludes other donor sites
    - Subscapular system rarely affected
    - Large vessel caliber
  - **Immediate mobility**
    - Older patients
    - Gait disturbance
  - **Low morbidity**
    - Primary closure
    - Shoulder dysfunction < 6 months
  - **No visible scar**

- So what defects would benefit from these advantages?

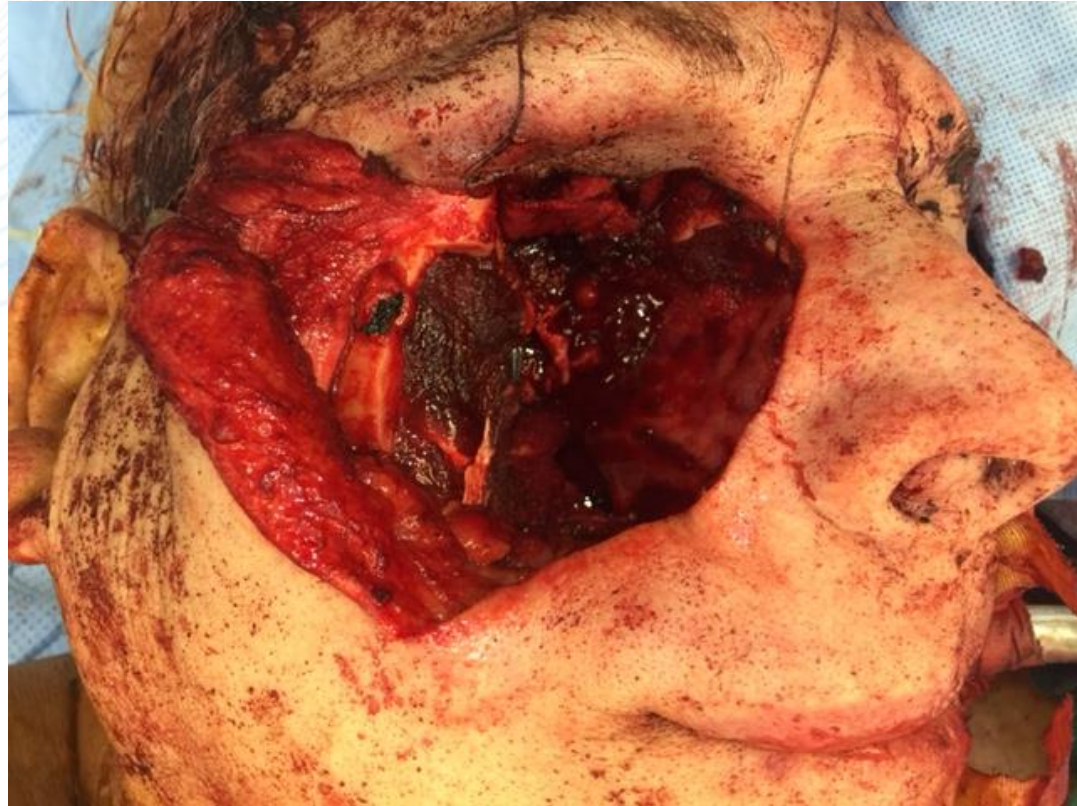
# Reconstruction of the Maxilla

- Goals
  - Aesthetic recovery
    - Restoration of projection of middle 1/3 of face
    - Support orbital cavity, nasal pyramid, lips, cheek
  - Functional rehabilitation
    - Labial competence
    - Mastication
    - Swallowing
    - Speech
    - Respiration

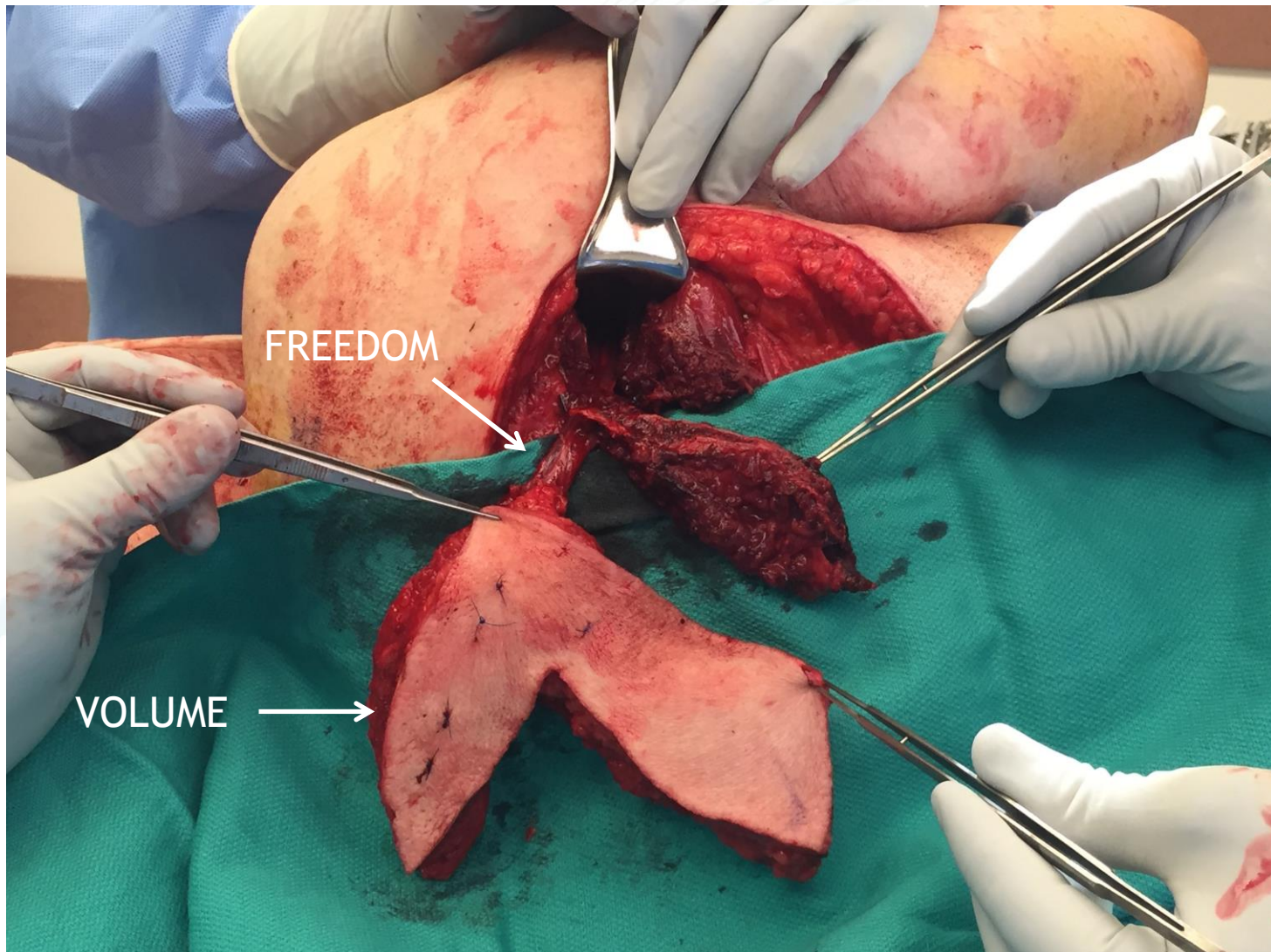




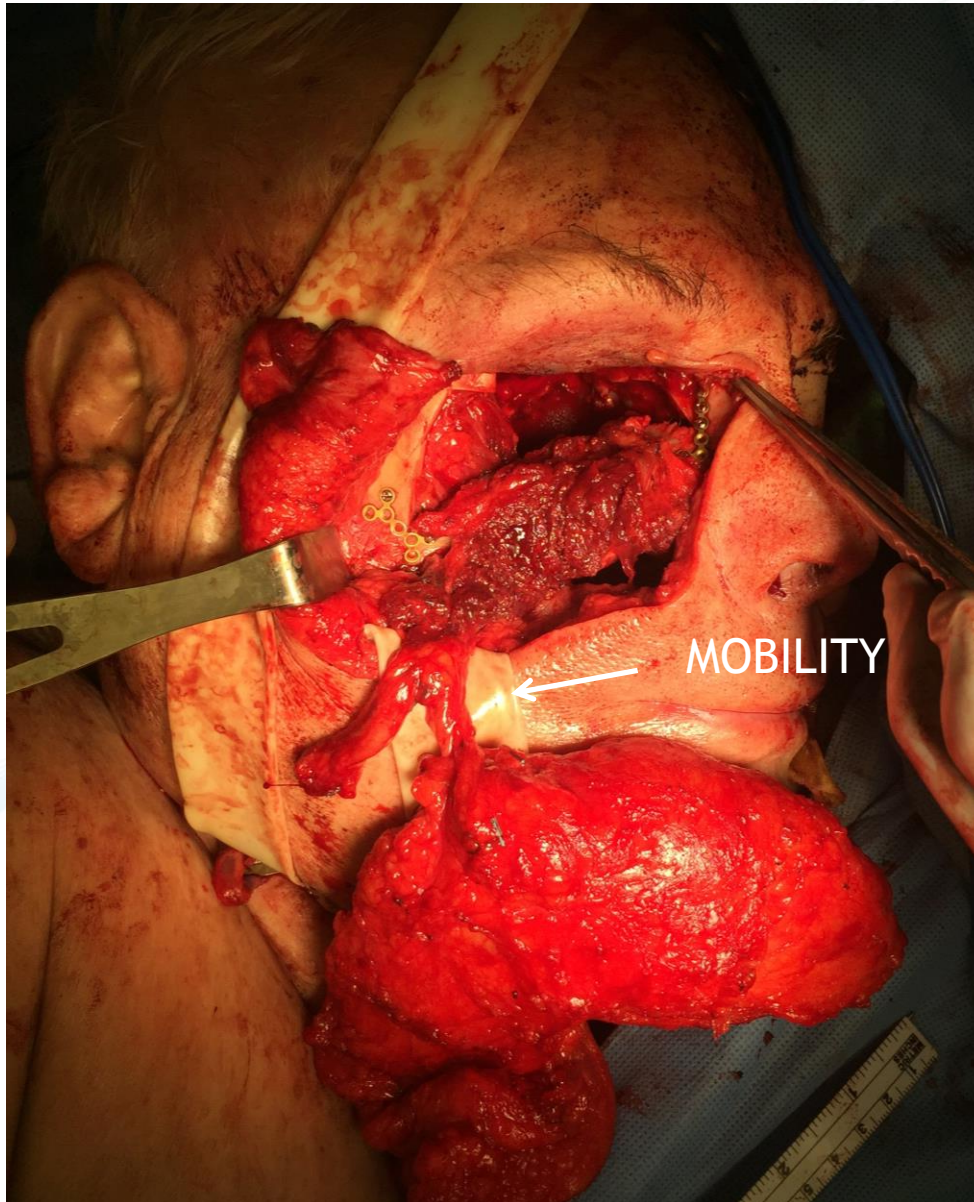
- Pathology: Maxillary SCC
- Defect:
  - inferior orbital rim
  - Orbital floor
  - Nasal wall
  - Hard palate
  - Malar skin
- Reconstruction:
  - Osteocutaneous Scapular/Parascapular Free Flap
  - Lateral border









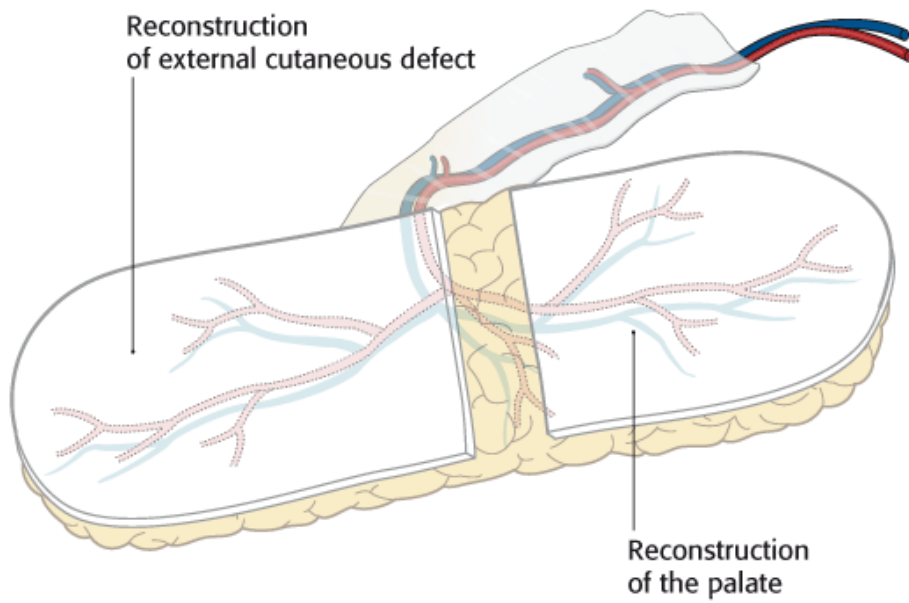


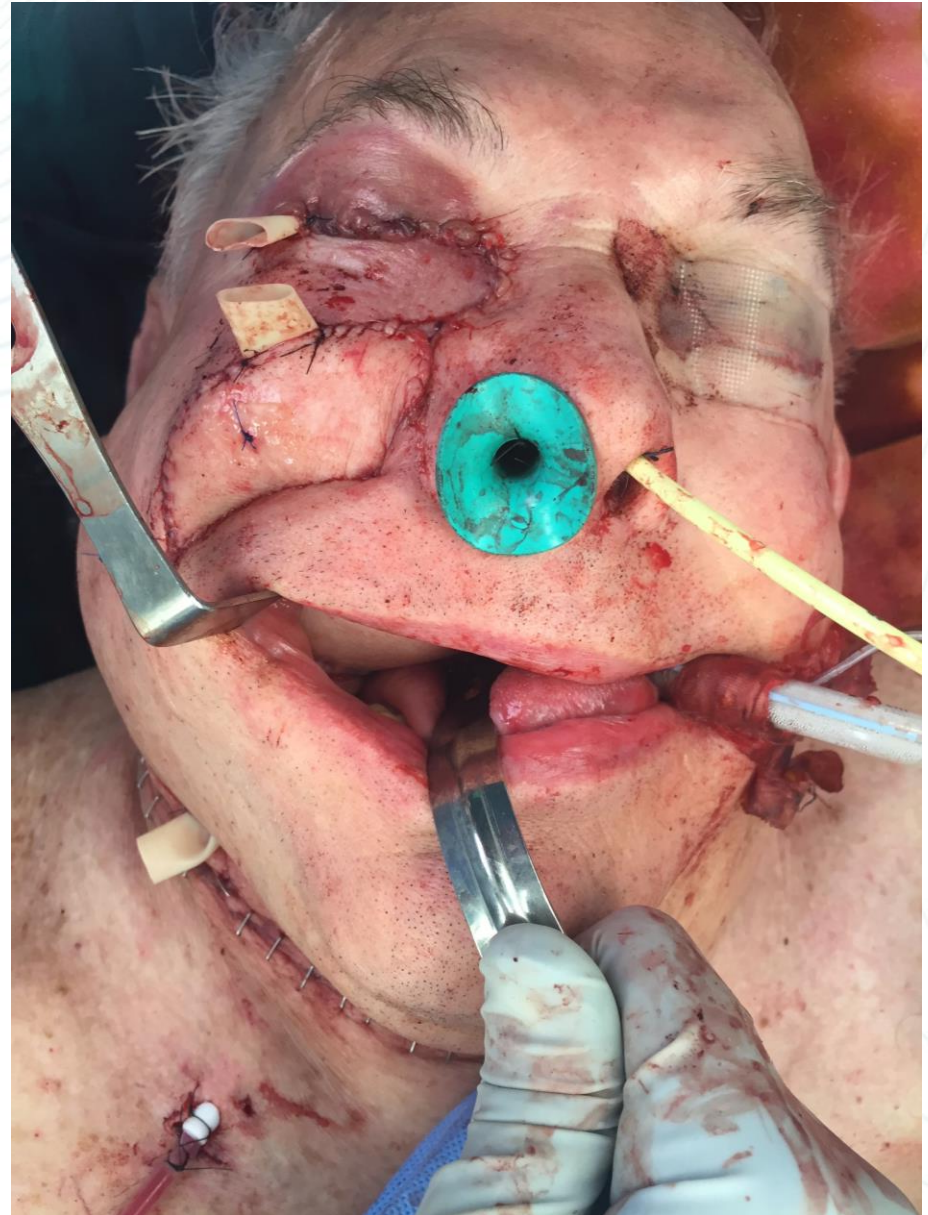
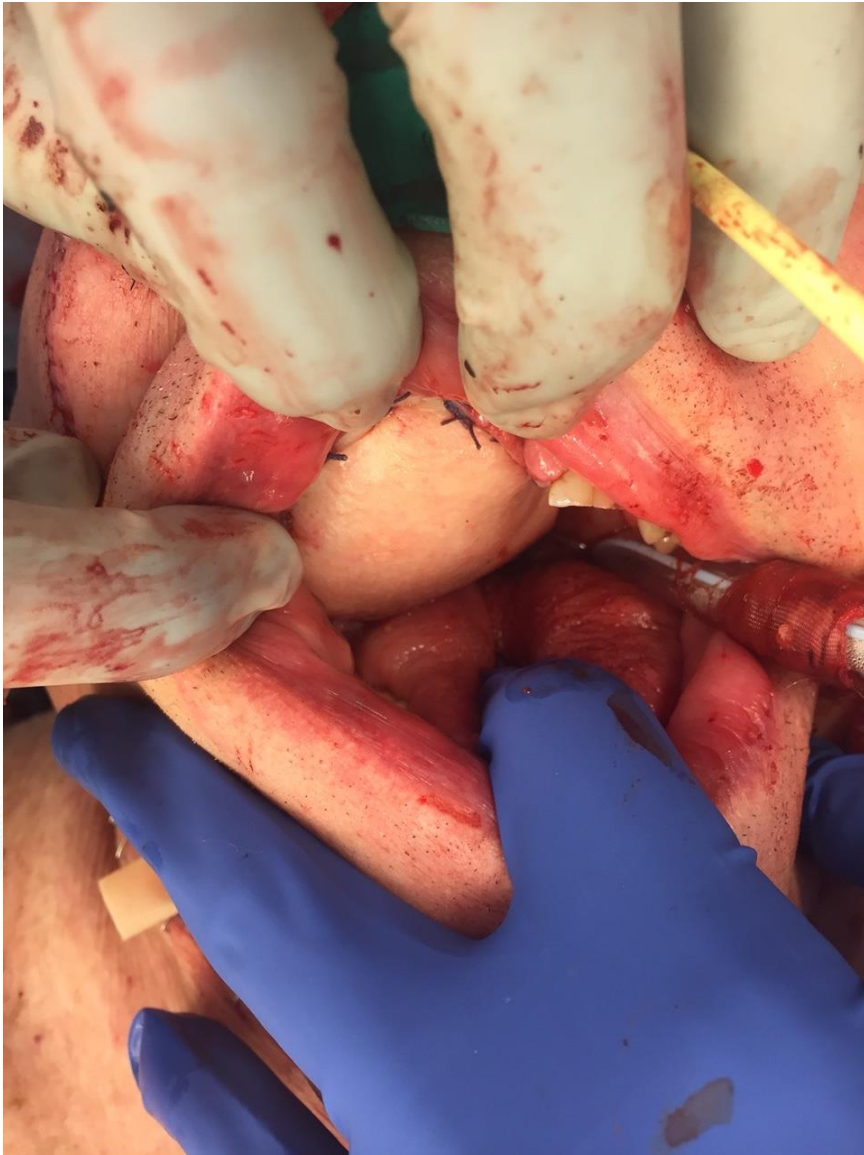
- Restoration of the inferior orbital rim



- Soft tissue bulk to the orbit







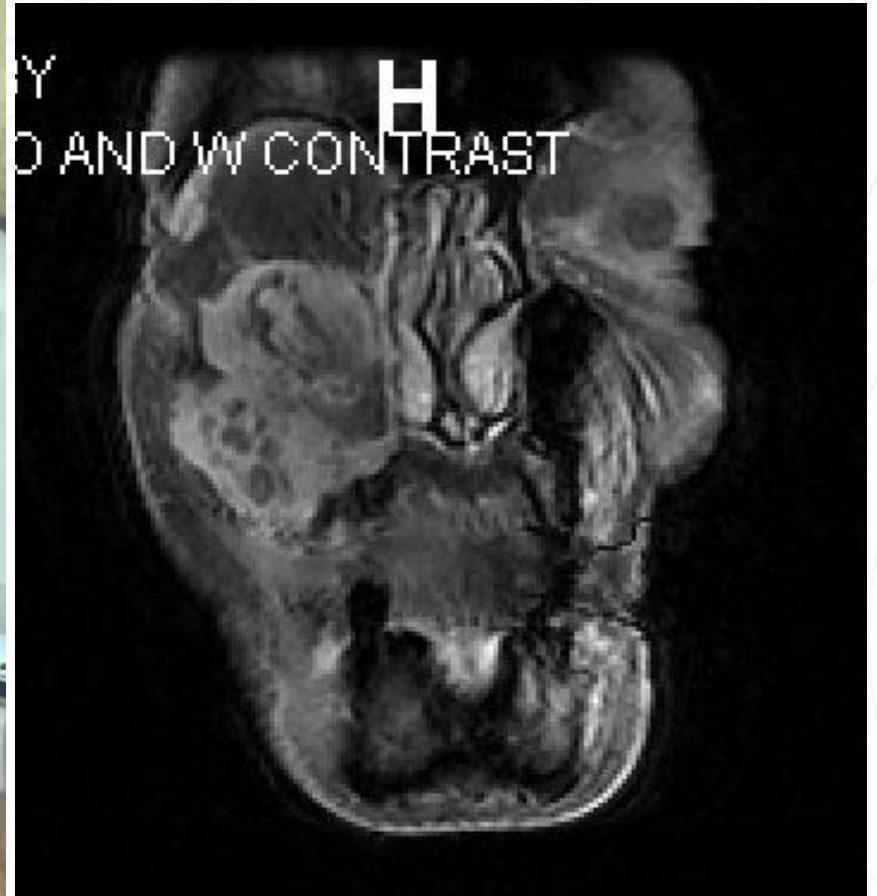




1 month



3 months



Case #1



- Pathology: Maxillary SCC
- Defect:
  - ZMC/inferior orbital rim
  - Orbital floor
  - Skull base
  - Nasal wall
  - Orbital/malar skin
- Reconstruction:
  - Osteocutaneous Scapular/Parascapular Free Flap
  - Lateral border, scapular tip





- Scapular and parascapular flaps
- 10 cm bone from lateral margin including tip



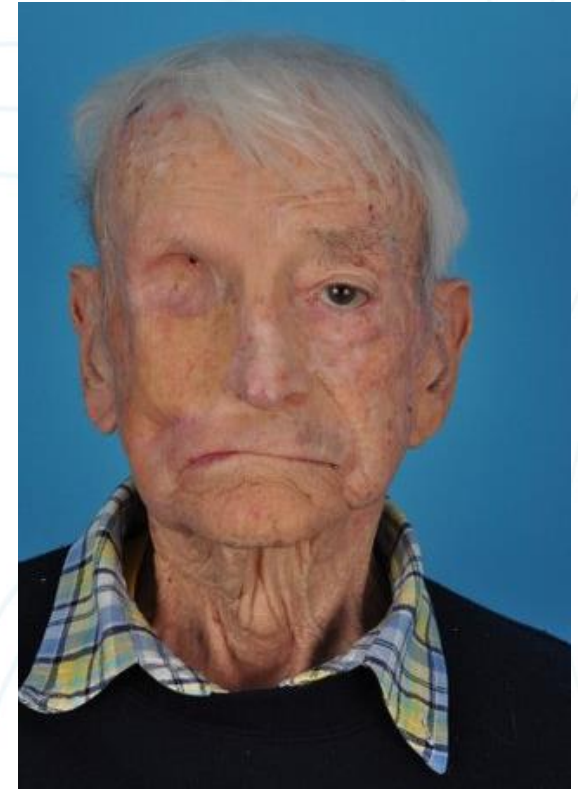




1 month

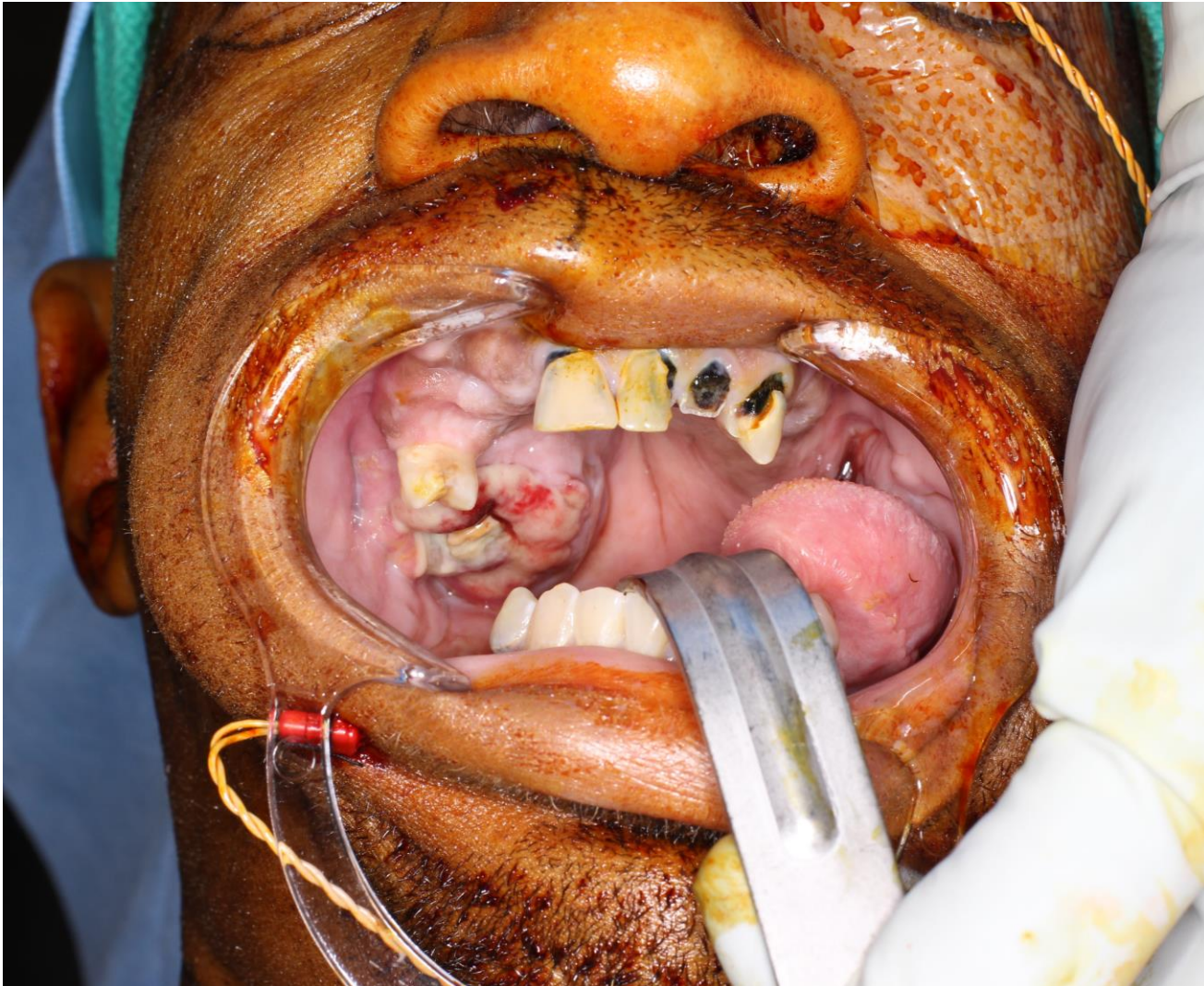


4 months



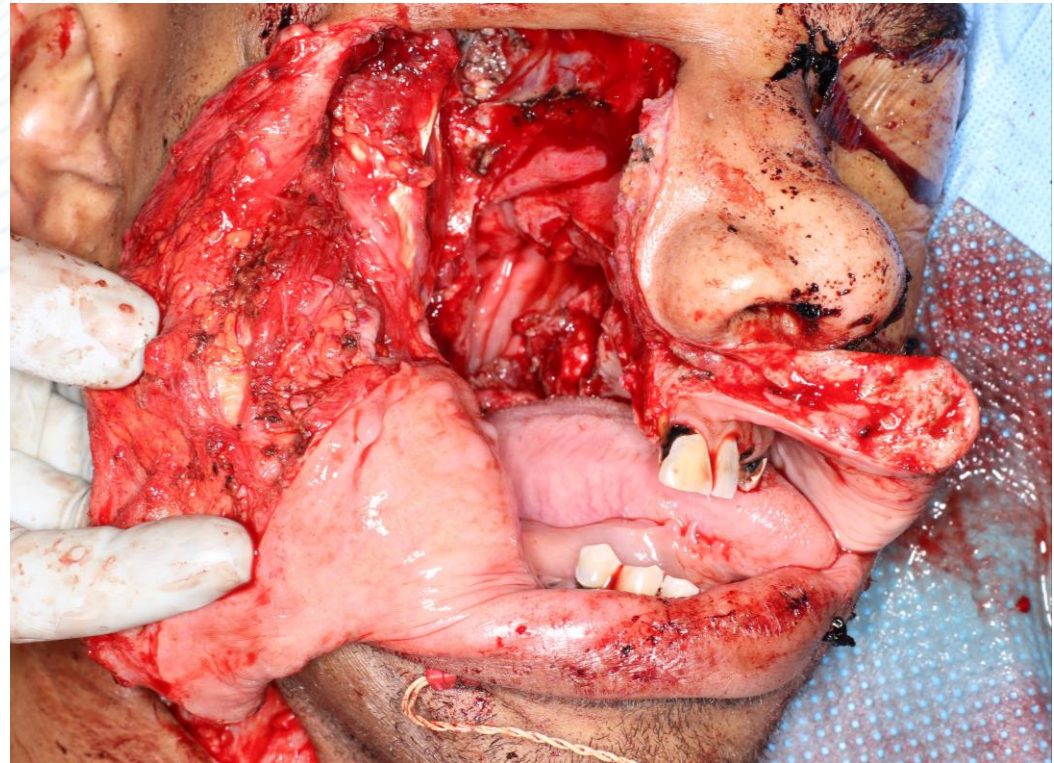
12 months



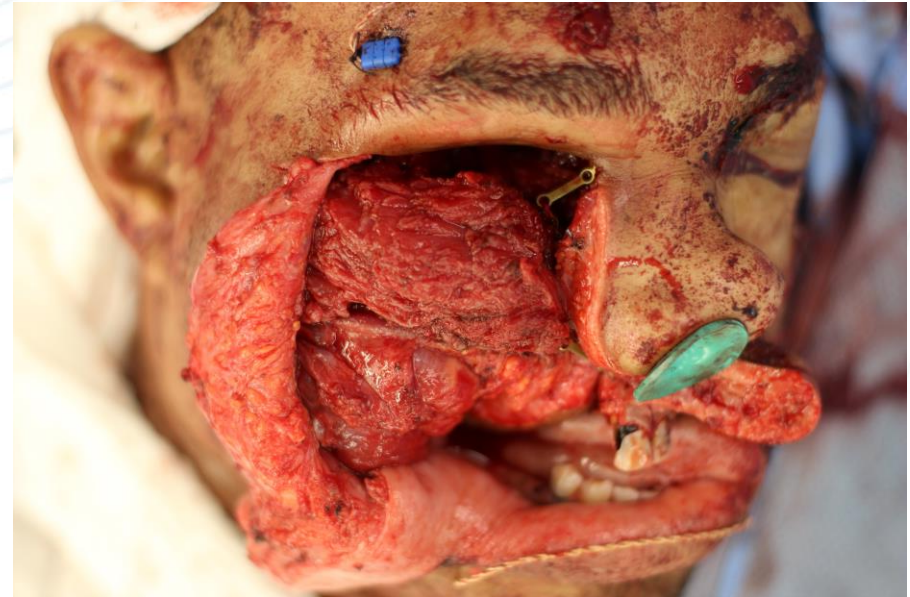


Case #4

- Pathology: Maxillary fibrosarcoma
- Defect:
  - ZMC/inferior orbital rim
  - Orbital floor
  - Nasal wall/floor
  - Hard/soft palate
  - Buccal mucosa
- Reconstruction:
  - Osteocutaneous Scapular/Parascapular Free Flap
  - Lateral border







- Osteotomy to shape the bone to ZMC
- Parascapular paddle for neo-palate and nasal wall
- Scapular paddle for cheek contour and dead space



# Reconstruction of the Mandible

- Goals
  - Aesthetic recovery
    - Restoration of mandibular continuity
  - Functional rehabilitation
    - Occlusion
    - Bony height
    - Oral competence
- Indications
  - Anterior with extensive tongue/FOM recon
  - Posterior with extensive OP resection
  - Through and through defects



- Pathology: Maxillary SCC
- Defect:
  - Mandible
  - FOM
  - Buccal mucosa
  - Upper, lower lip
  - External cheek
- Reconstruction:
  - Osteocutaneous Scapular/Parascapular Free Flap
  - Lateral border

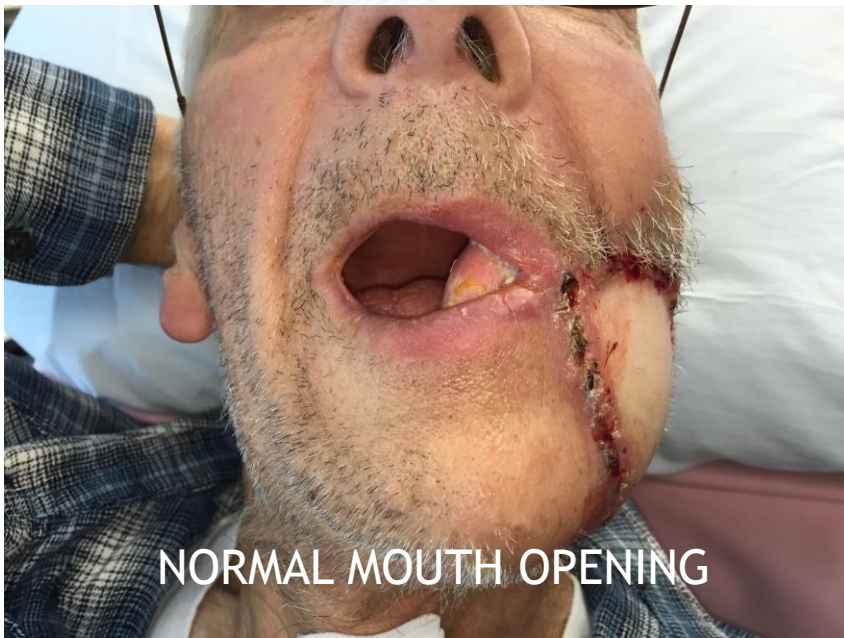


Case #5

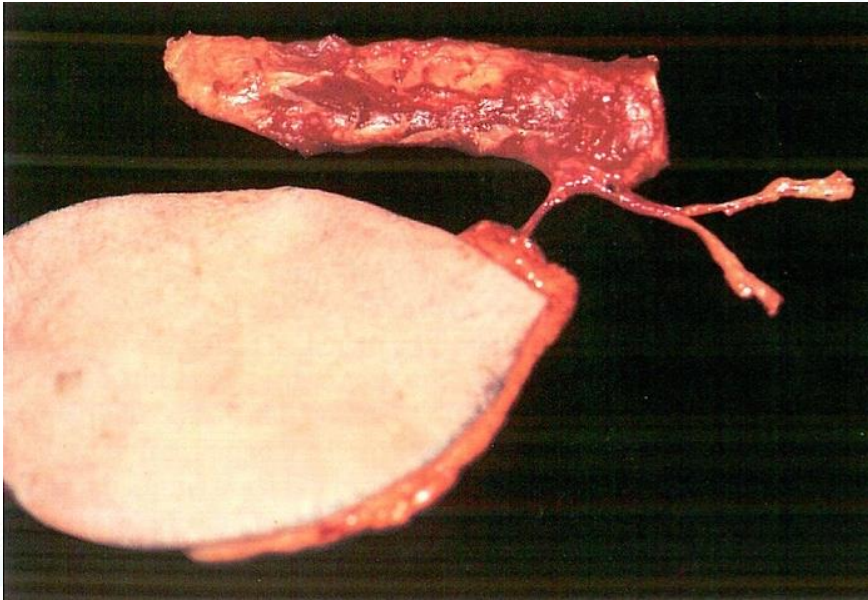




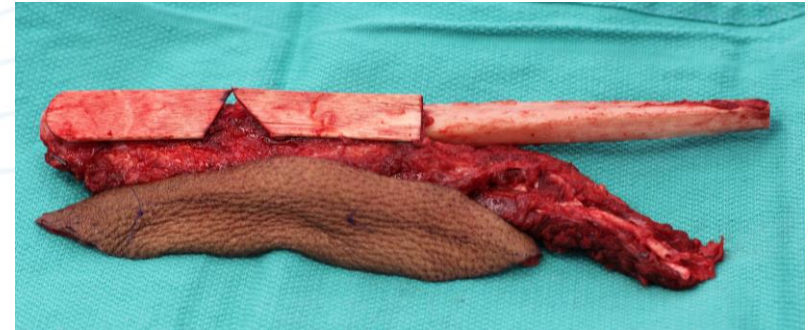








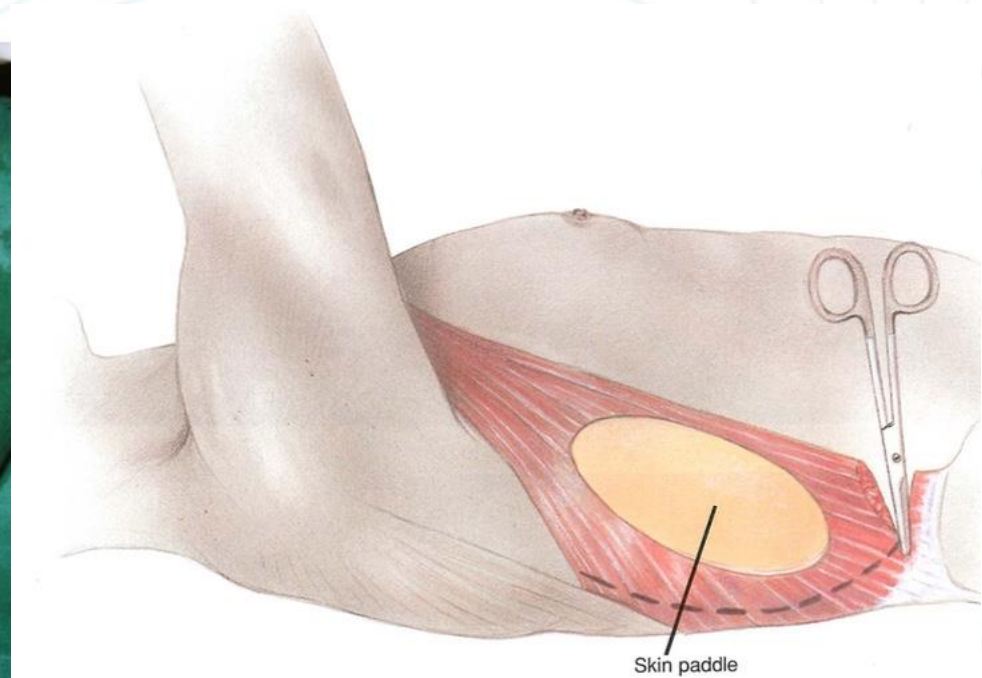
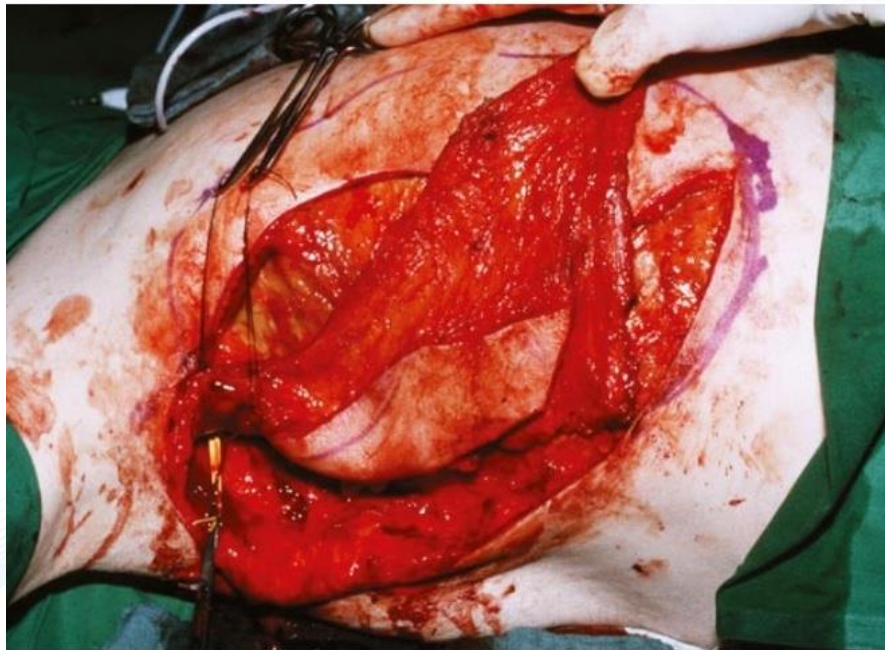
SCAPULA



FIBULA

VS

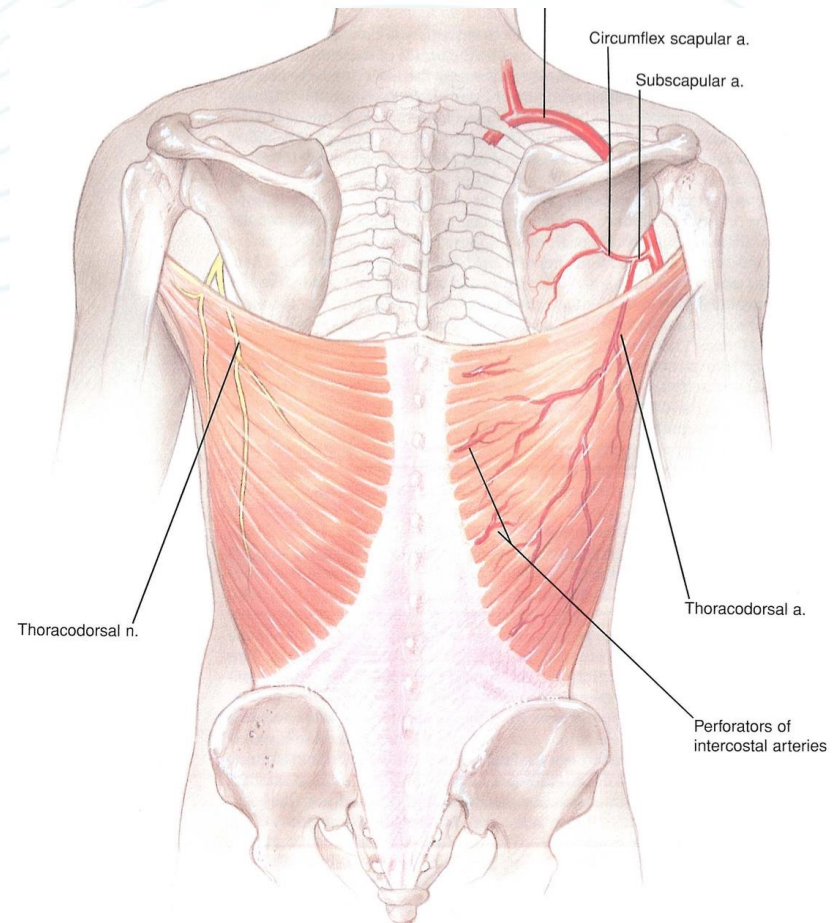
# Latissimus Dorsi Flap





## Relevant Anatomy

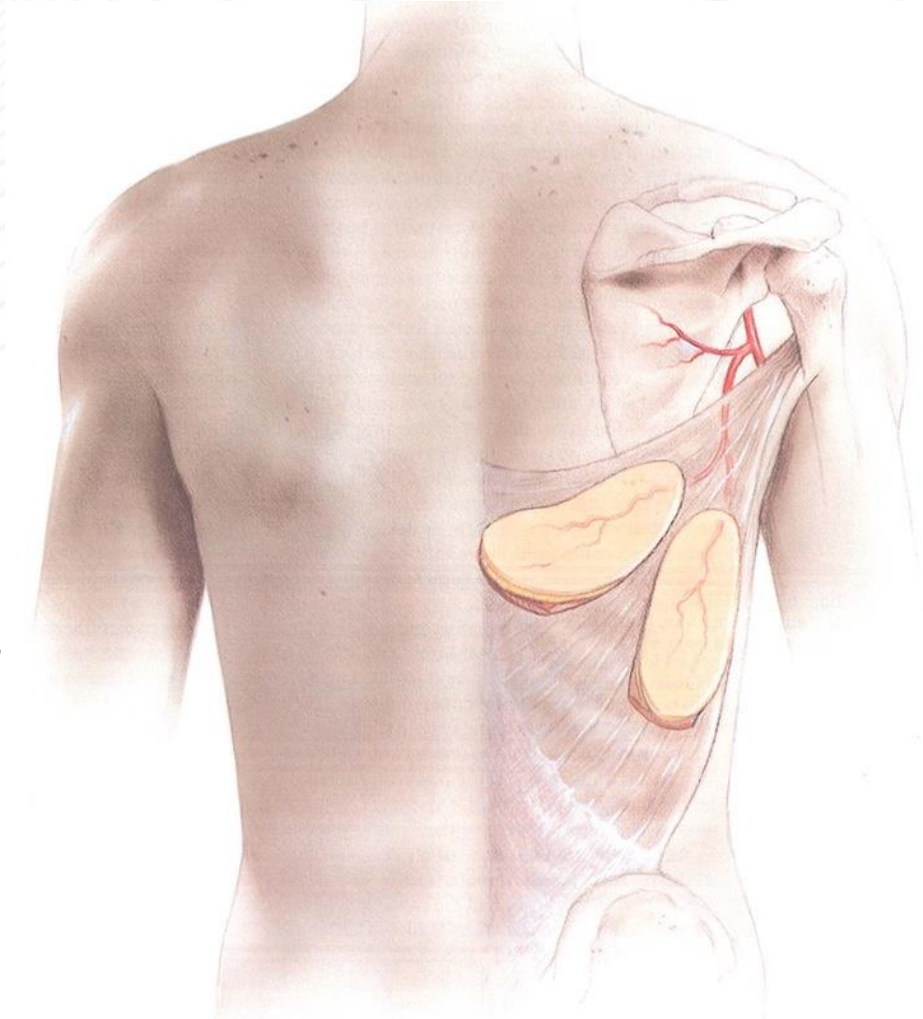
- Broad, flat muscle
  - Origin: T1-T6, thoracodorsal fascia, iliac crest
  - Insertion: humerus
- Total area 25-40 cm<sup>2</sup>
- Forms posterior axillary fold
- Major actions
  - Adduction
  - Internal rotation
  - Extension





## Relevant Anatomy

- Pedicle:
  - **Thoracodorsal A.**
    - Length: 7-12 cm
    - Diameter: 2-5 mm
- Branches medially and laterally
  - Option for multiple paddles



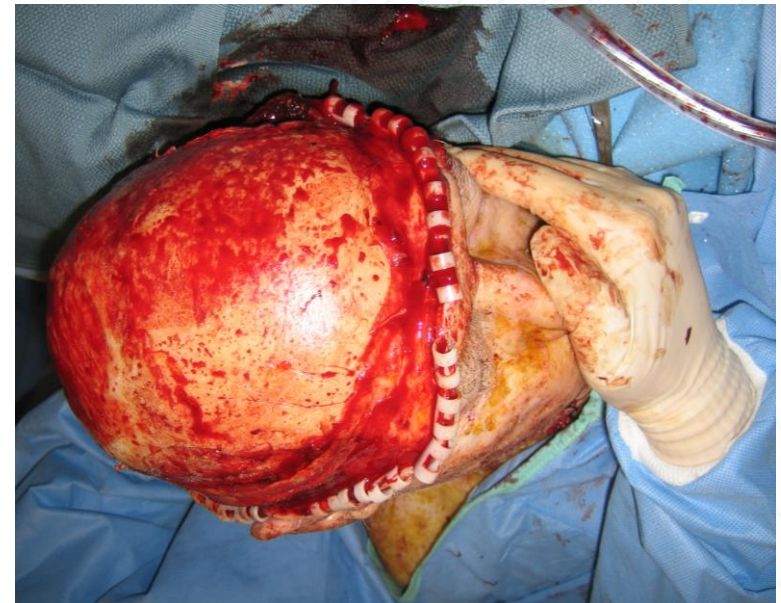
# Flap Design

- Large quantity of soft tissue
  - Muscle
    - 35 x 20 cm (700 cm<sup>2</sup>)
  - Skin
    - 18-35 cm x 7-20 cm (700 cm<sup>2</sup>)
    - Primary closure
  - Rib bone
    - 1.5-8 cm
    - Morphologic similarity to mandible
- Morbidity
  - Seroma
  - Wound dehiscence



## Latissimus Dorsi

- Pathology: BCC
- Defect: scalp skin
- Reconstruction:  
Latissimus Dorsi  
myocutaneous free  
flap







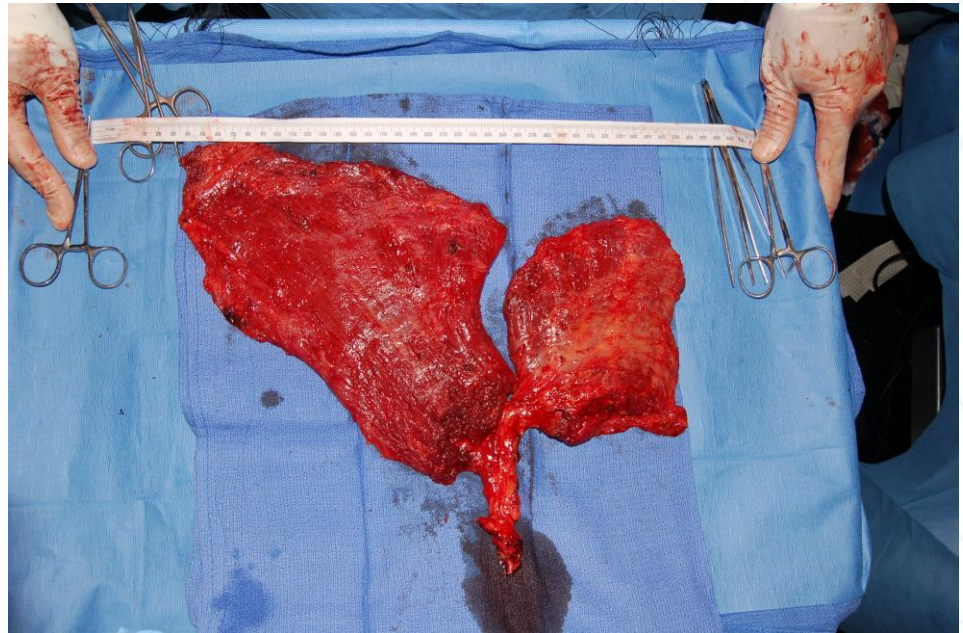
Post-op



3 months

## Chimeric Lat Flaps

- Largest surface area of bone-containing soft tissue based on one pedicle
- Further versatility for rebuilding large, composite defects
  - Orbital Floor
  - Hard Palate
  - Mandibular angle

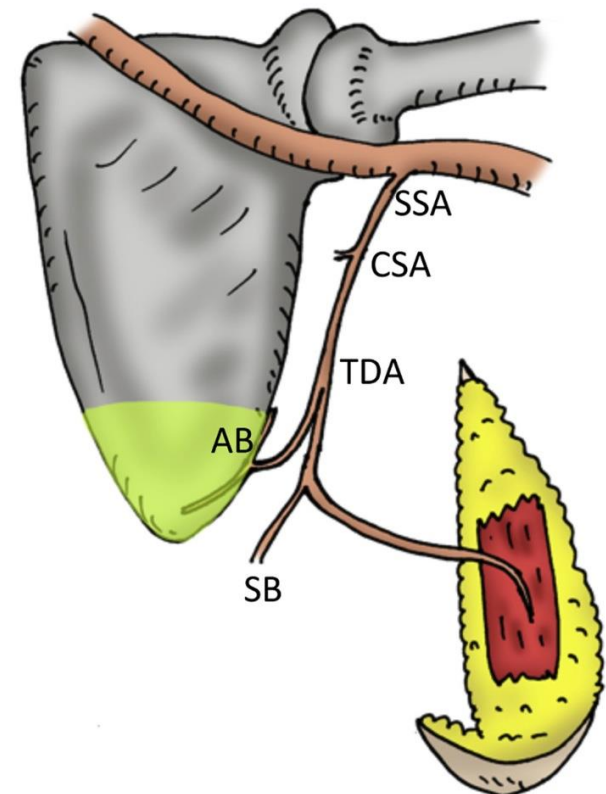
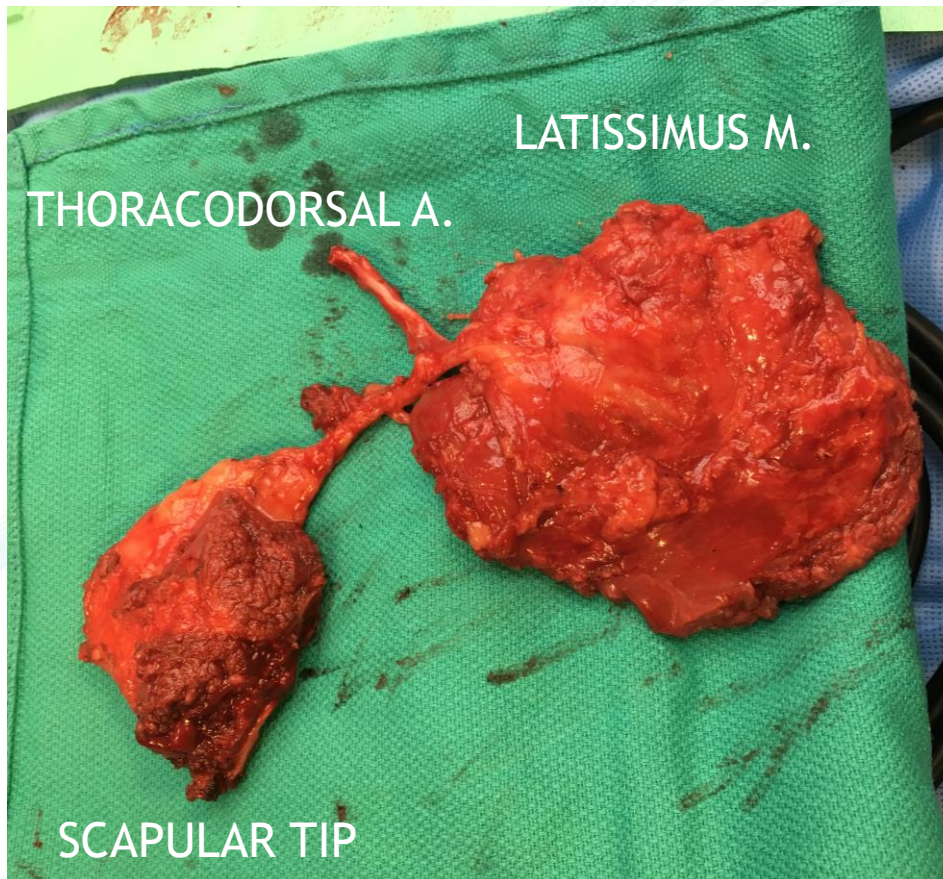


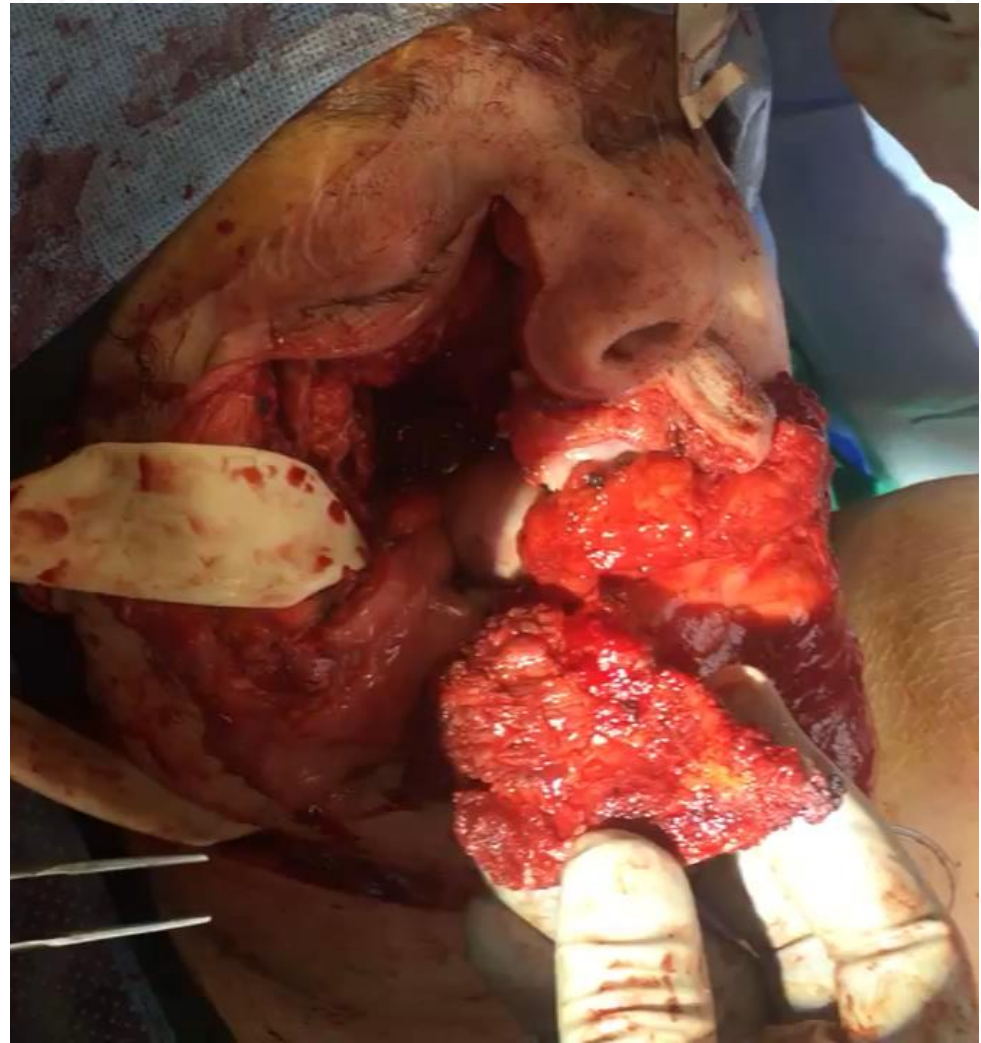
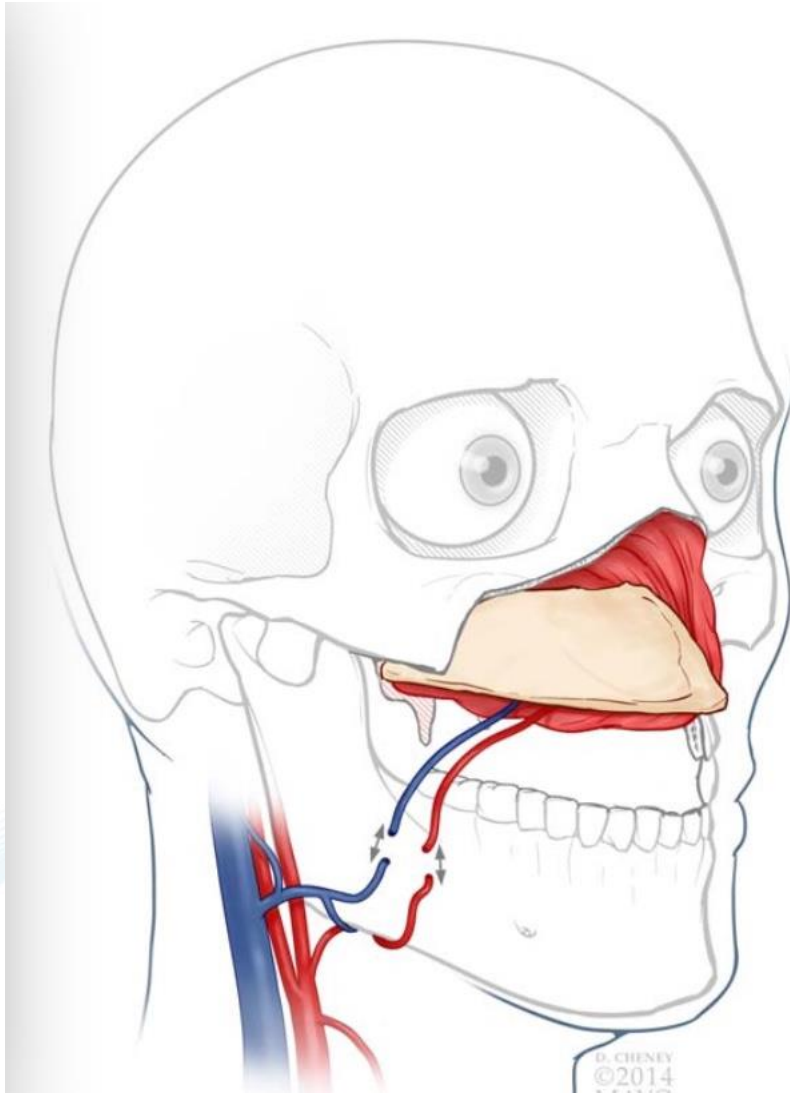




- Pathology: Mucosal Melanoma
- Defect: orbital rim, floor, ZMC, hard palate, soft palate
- Reconstruction: Combined Latissimus Dorsi and Scapular Angle Osseous Free Flap











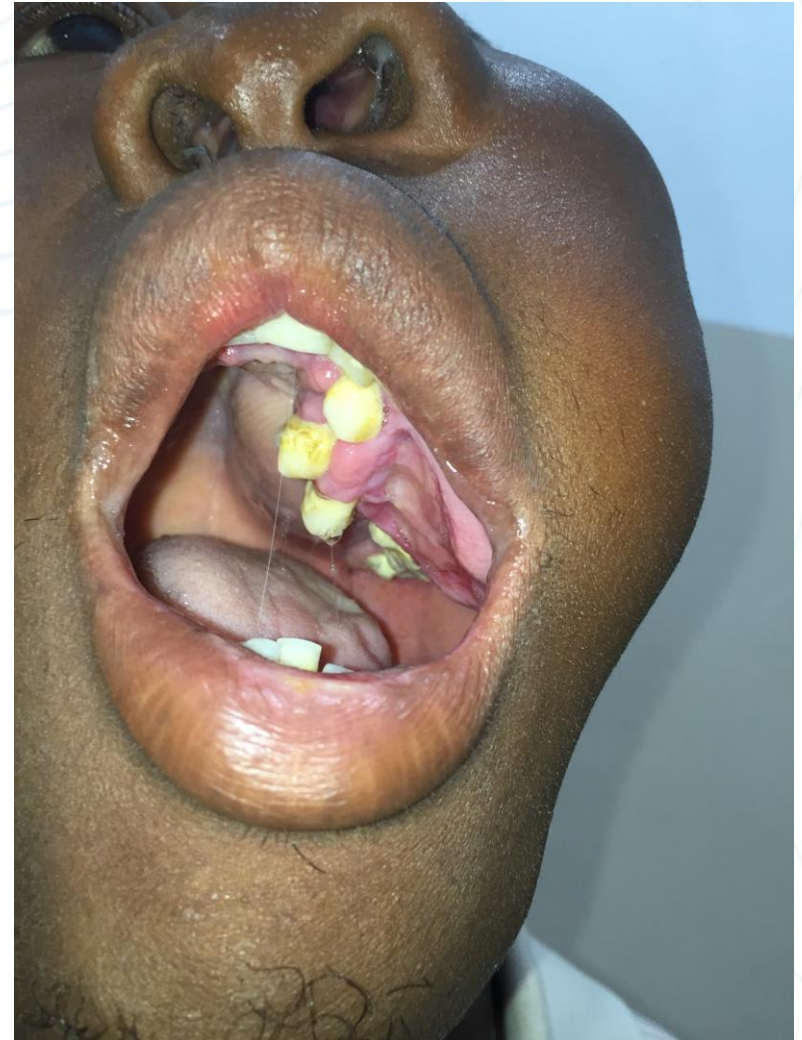
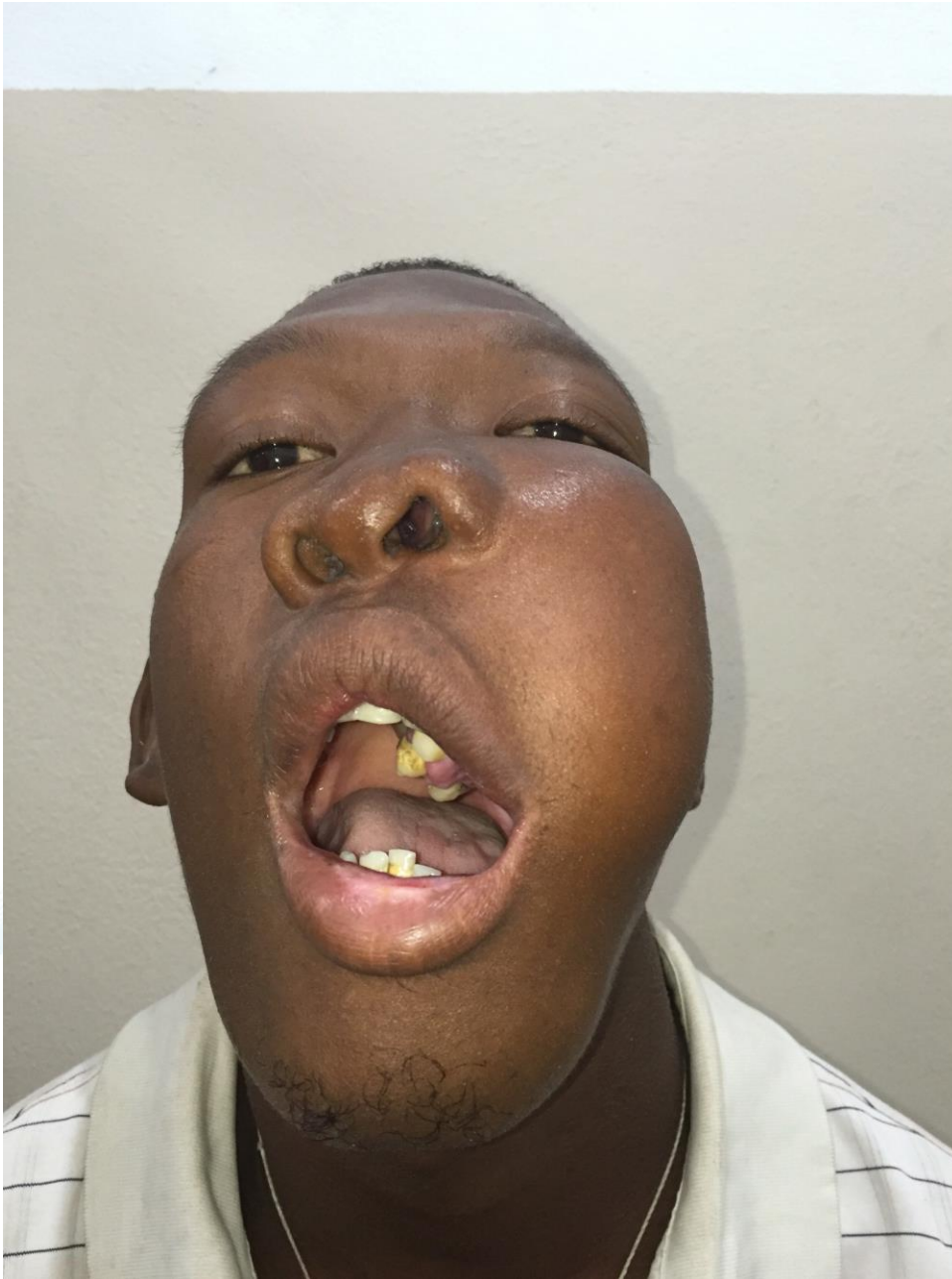




10 days post-op

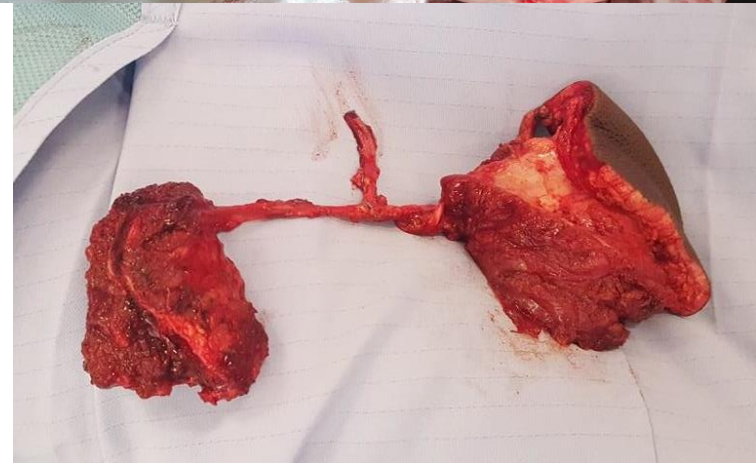
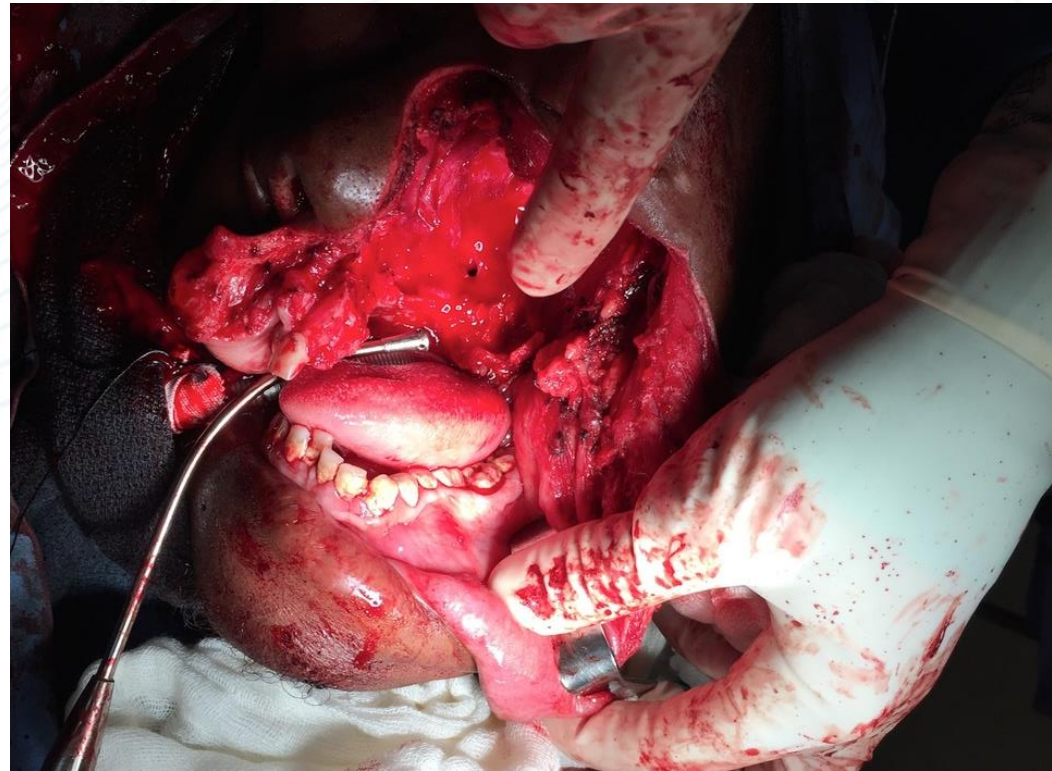


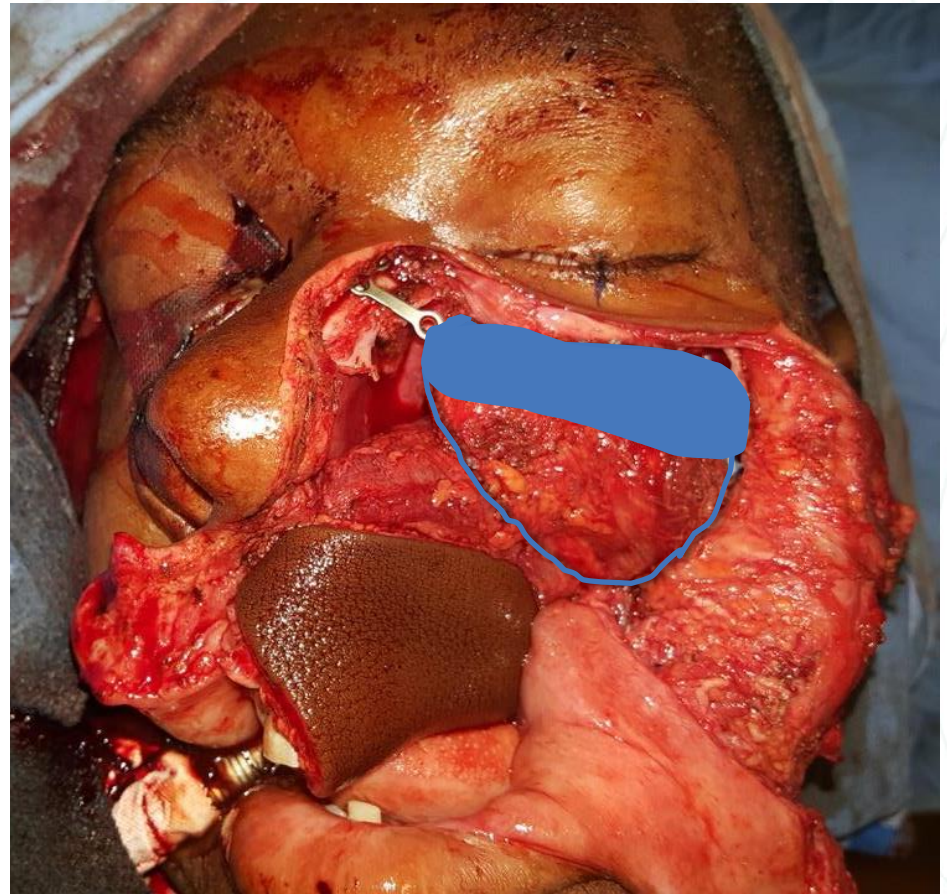
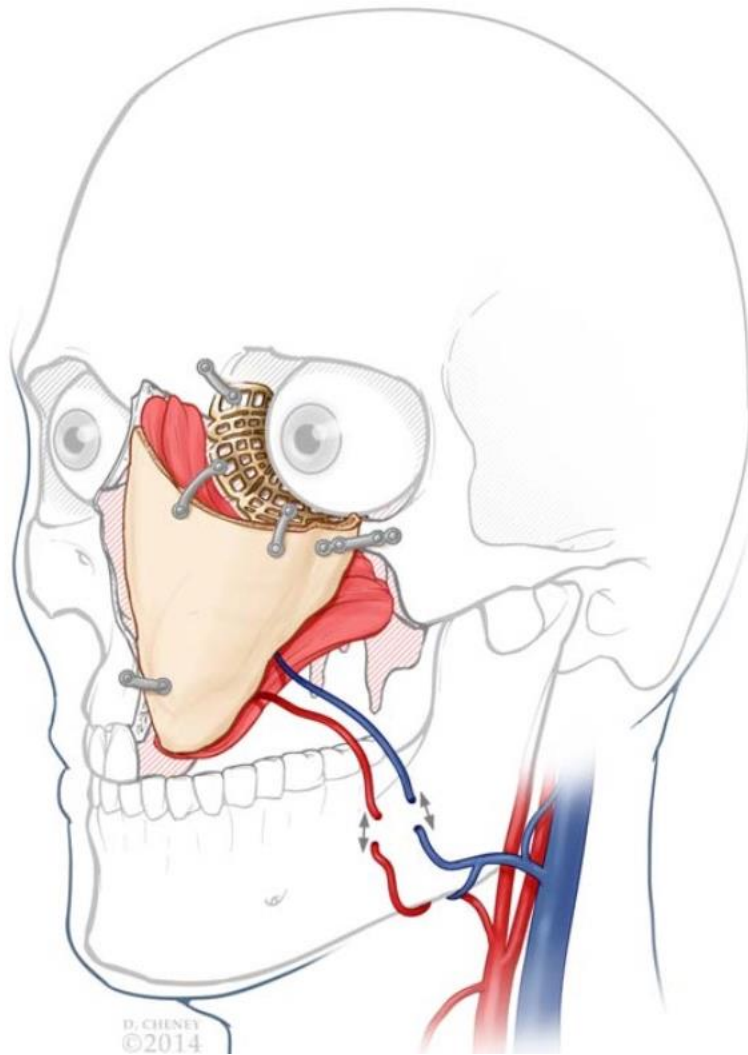
2 months post-op





- Pathology: ???
- Defect:
  - ZMC/inferior orbital rim
  - Hard palate
- Reconstruction:
  - Combined Latissimus Dorsi and Scapular Angle Osseous Free Flap

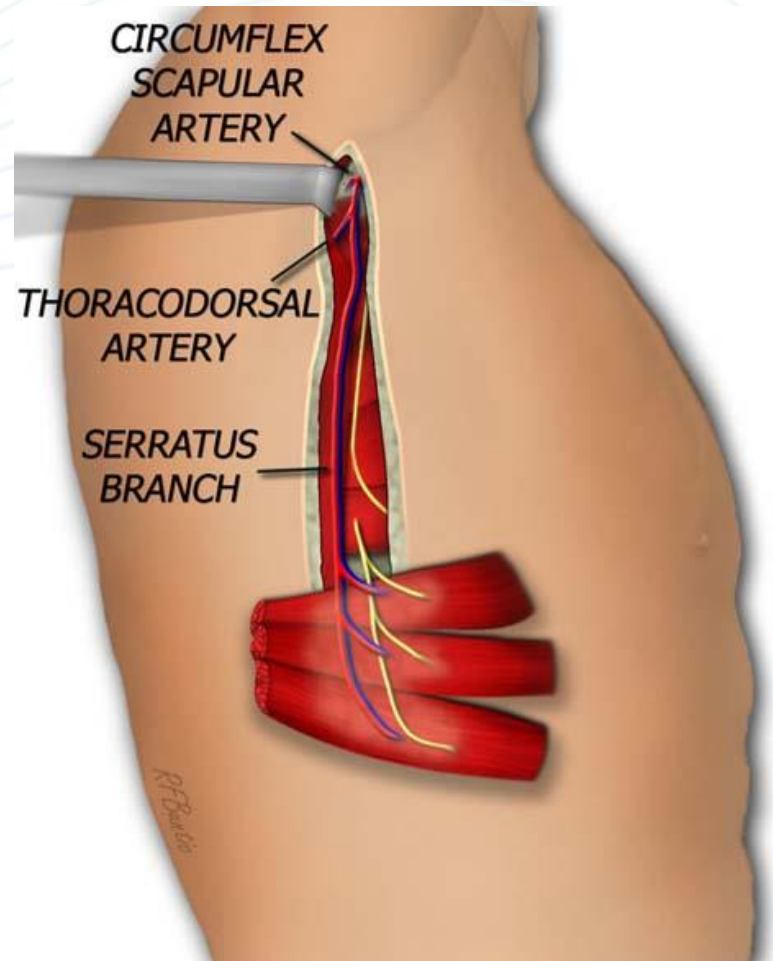








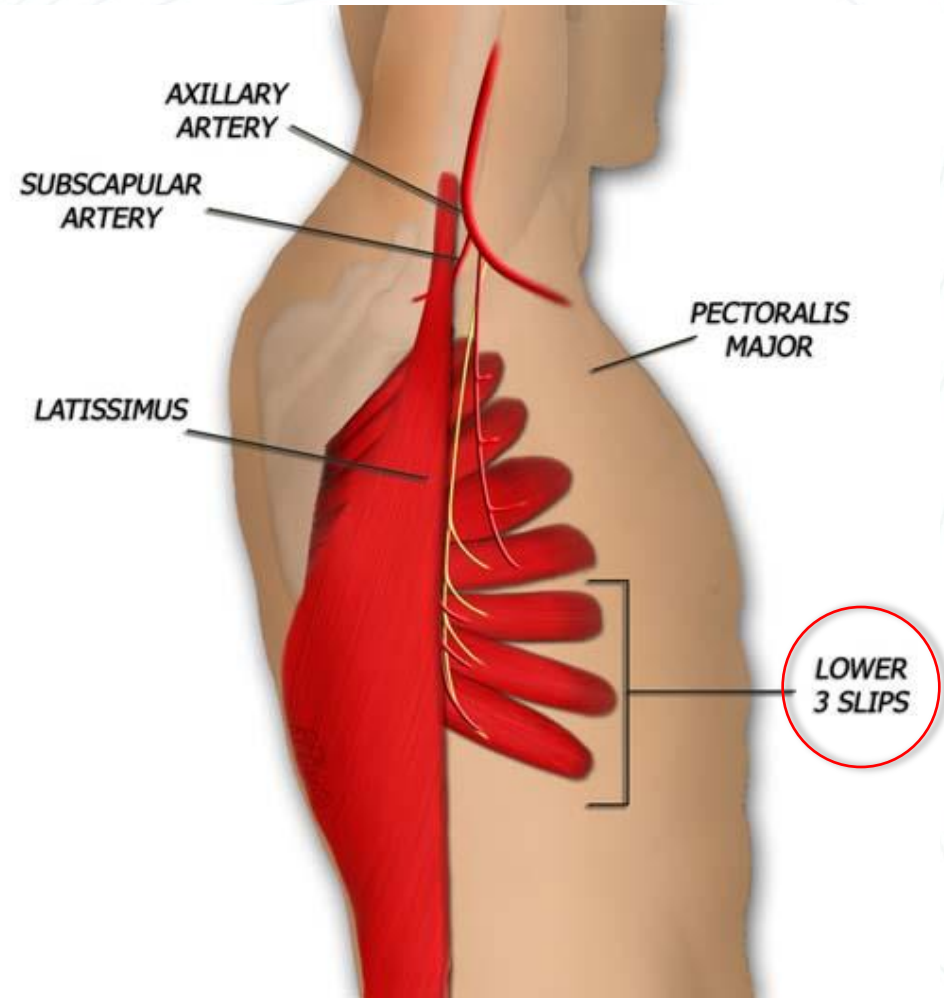
# Serratus Anterior Flap





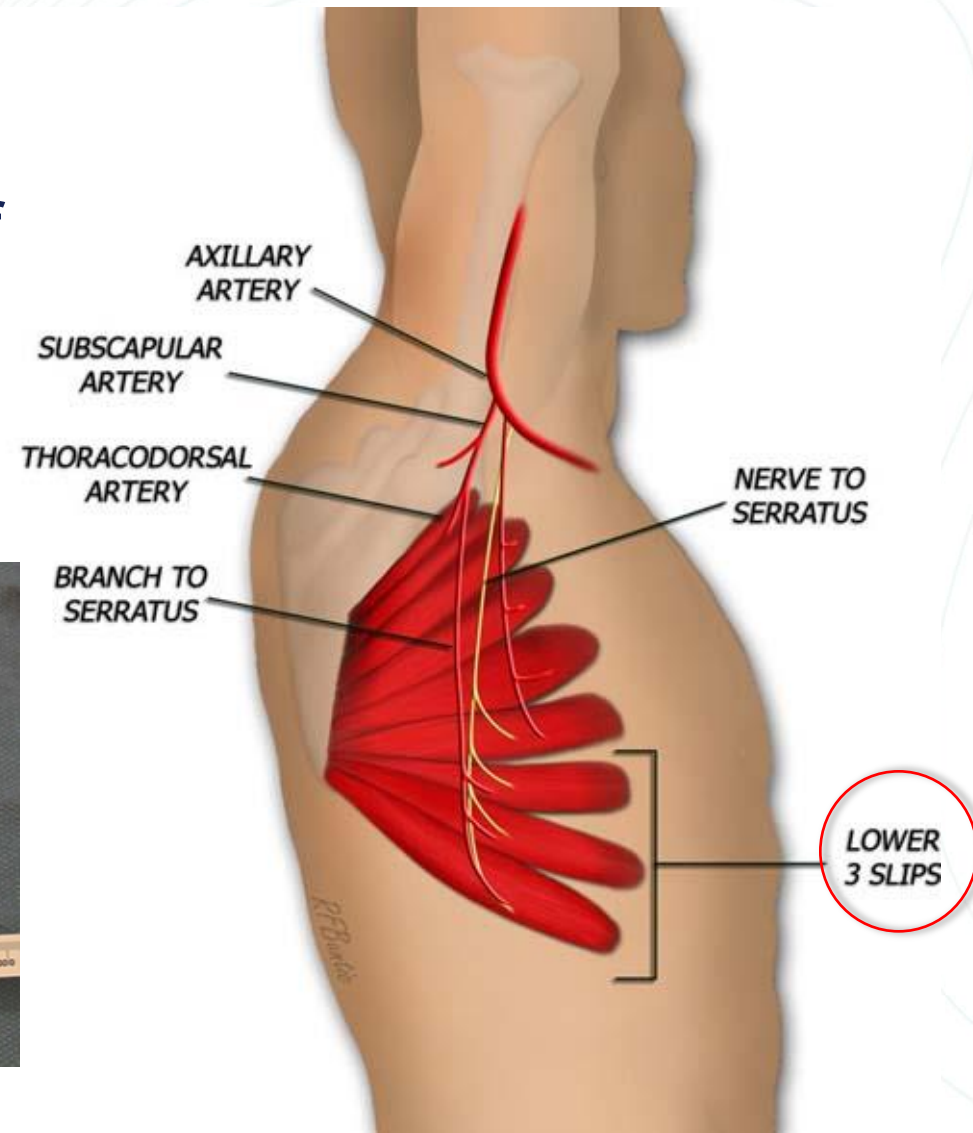
## Relevant Anatomy

- Broad fan-shaped muscle
  - Origin: ribs 1-9
  - Insertion: scapula
- Medial wall of axilla
- Action: stabilize scapula, upward rotation of the arm



## Relevant Anatomy

- Pedicle: Serratus branch of thoracodorsal artery
  - Length: 11-17 cm
  - Diameter: 2-3 mm





# Flap Planning

- Indications
  - Soft tissue dimensions: 10 cm x 7 cm
    - Scalp
    - Maxilla
    - Mandible
    - Oral Cavity
    - Skull base
    - Craniofacial defects
- Morbidity
  - Seroma
  - Wound dehiscence
  - Scapular winging
  - Pneumothorax

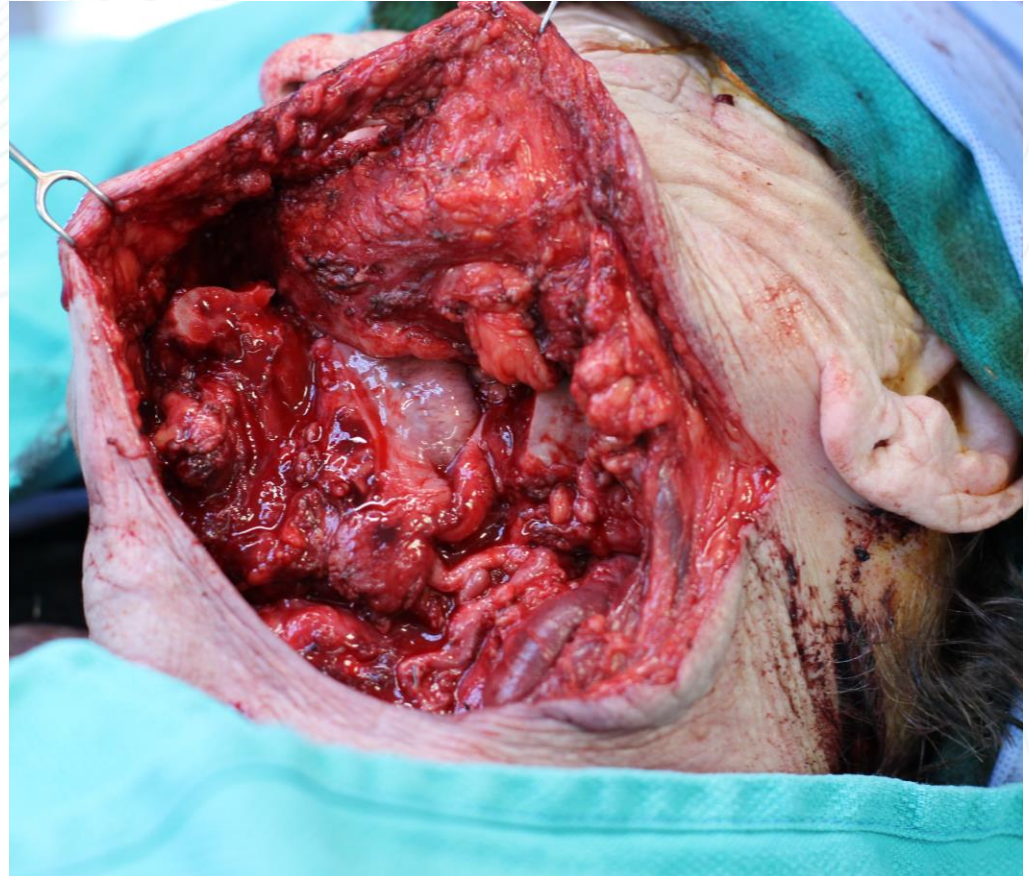




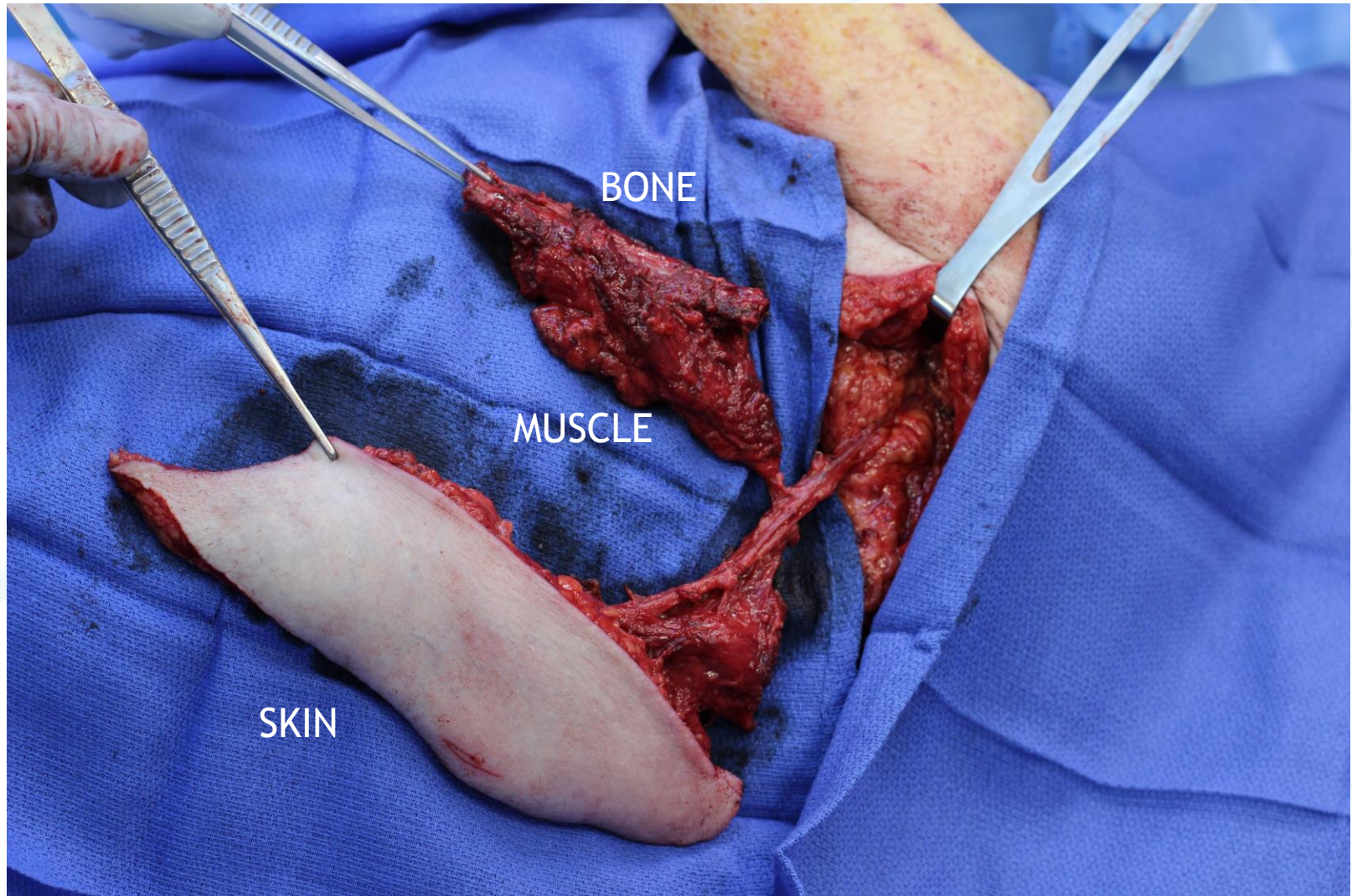
Case #9



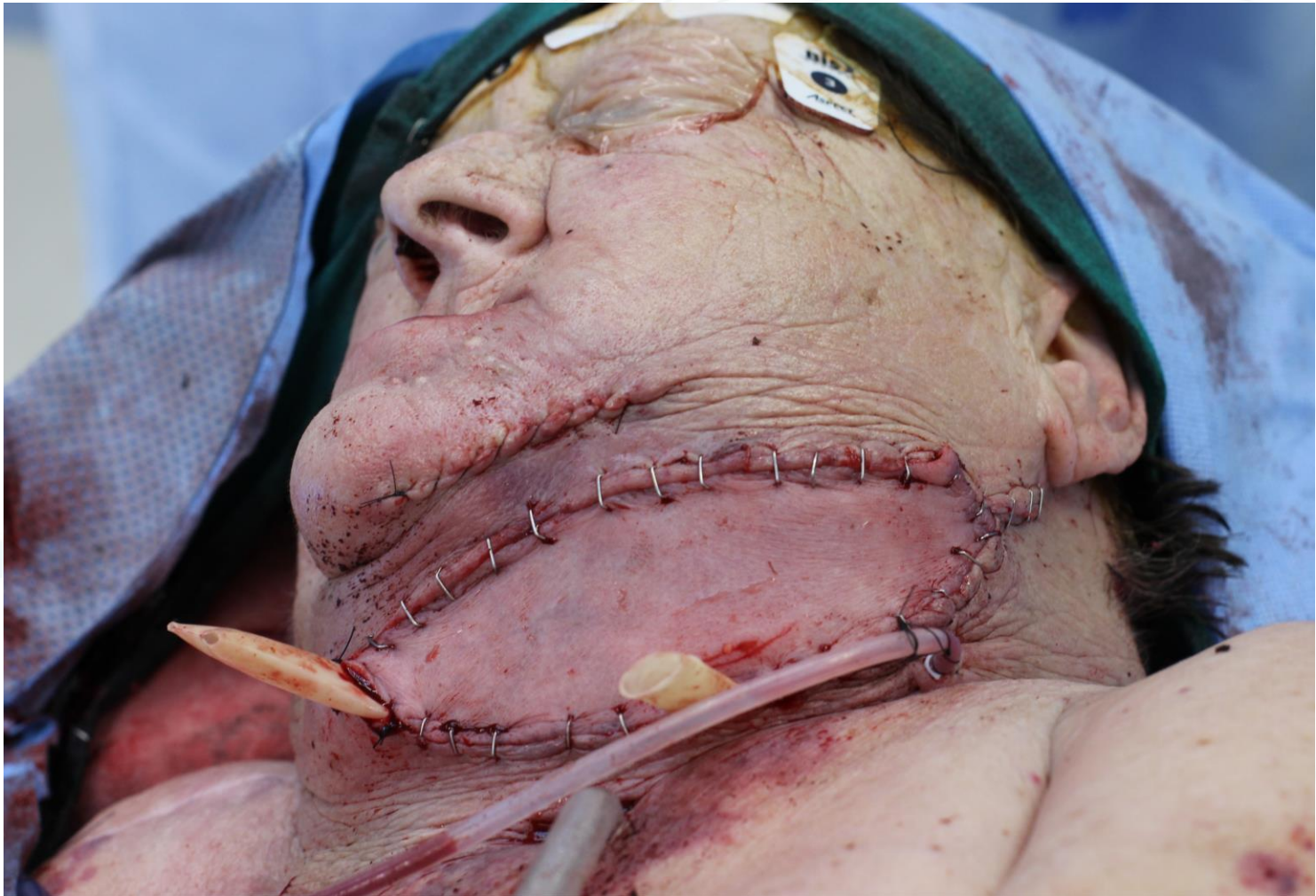
- Pathology: SCC
- Defect: mandible, FOM, neck skin
- Reconstruction: serratus rib with myocutaneous latissimus dorsi free flap

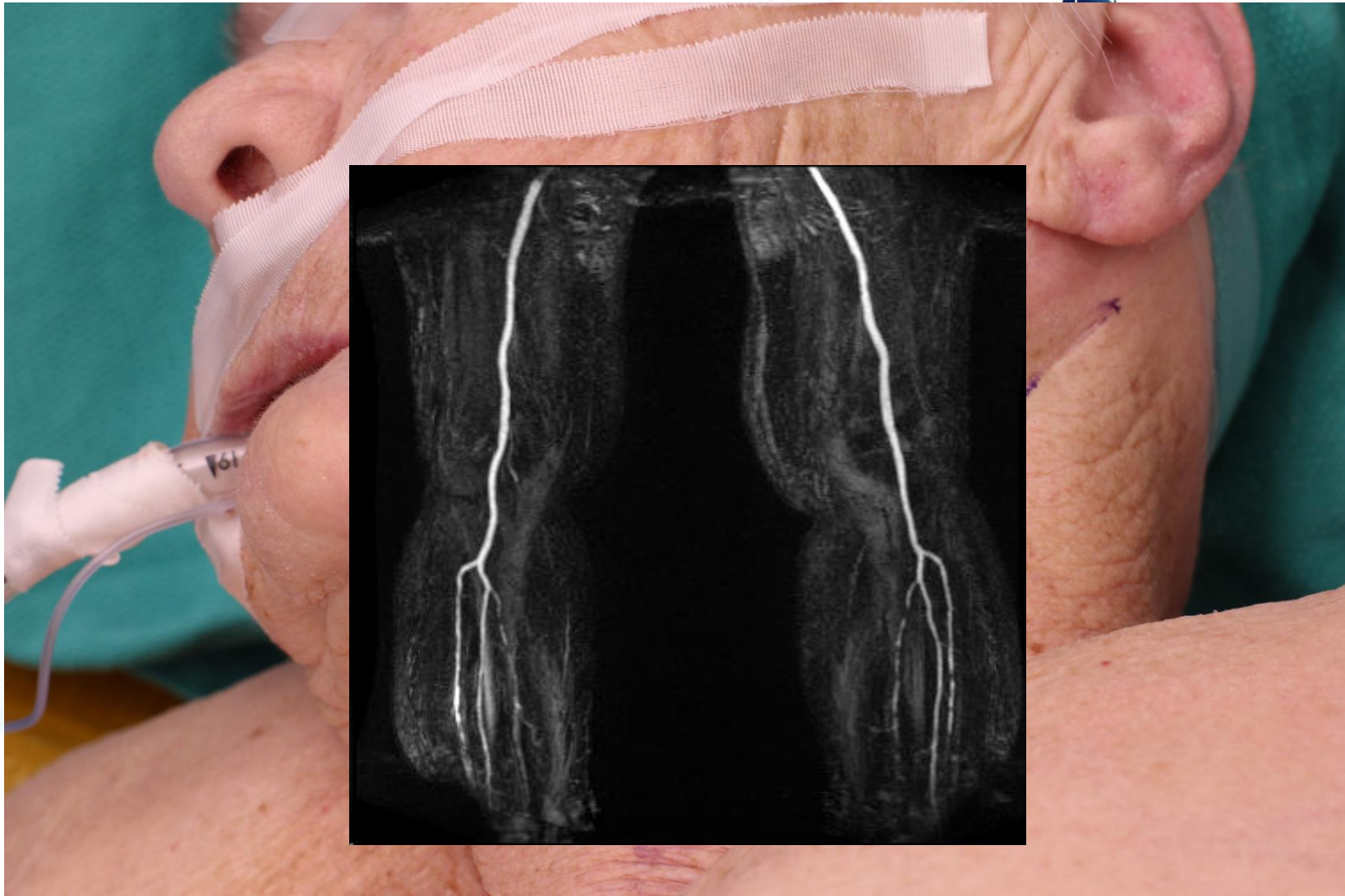






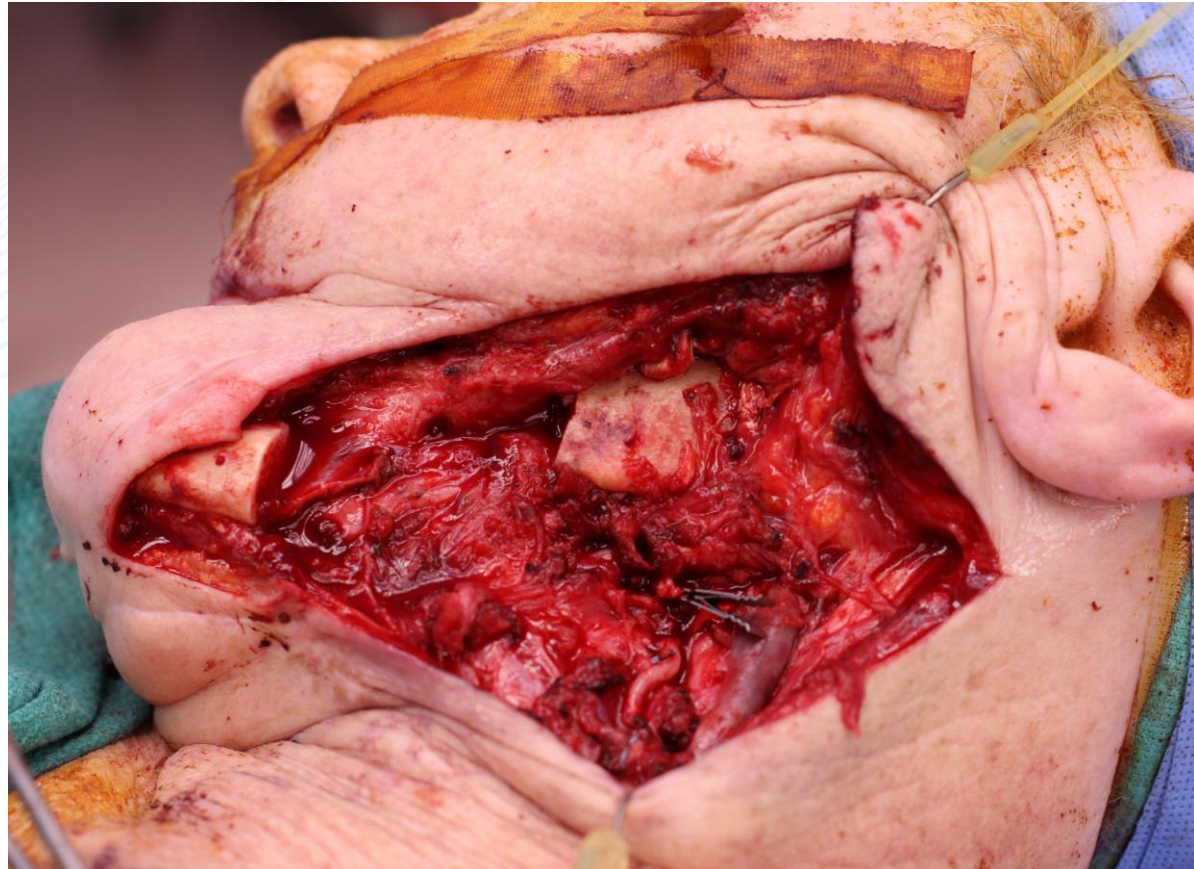




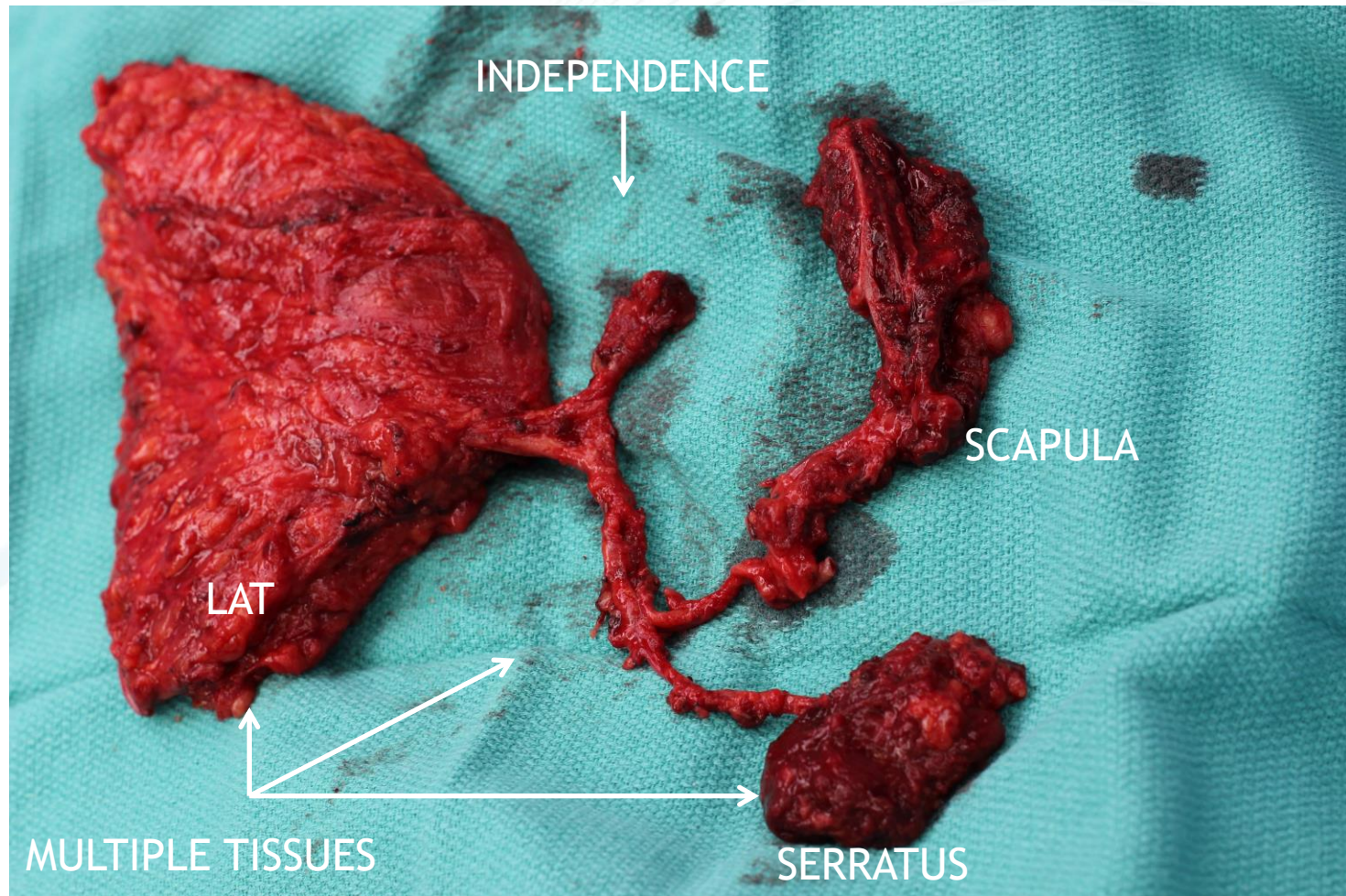




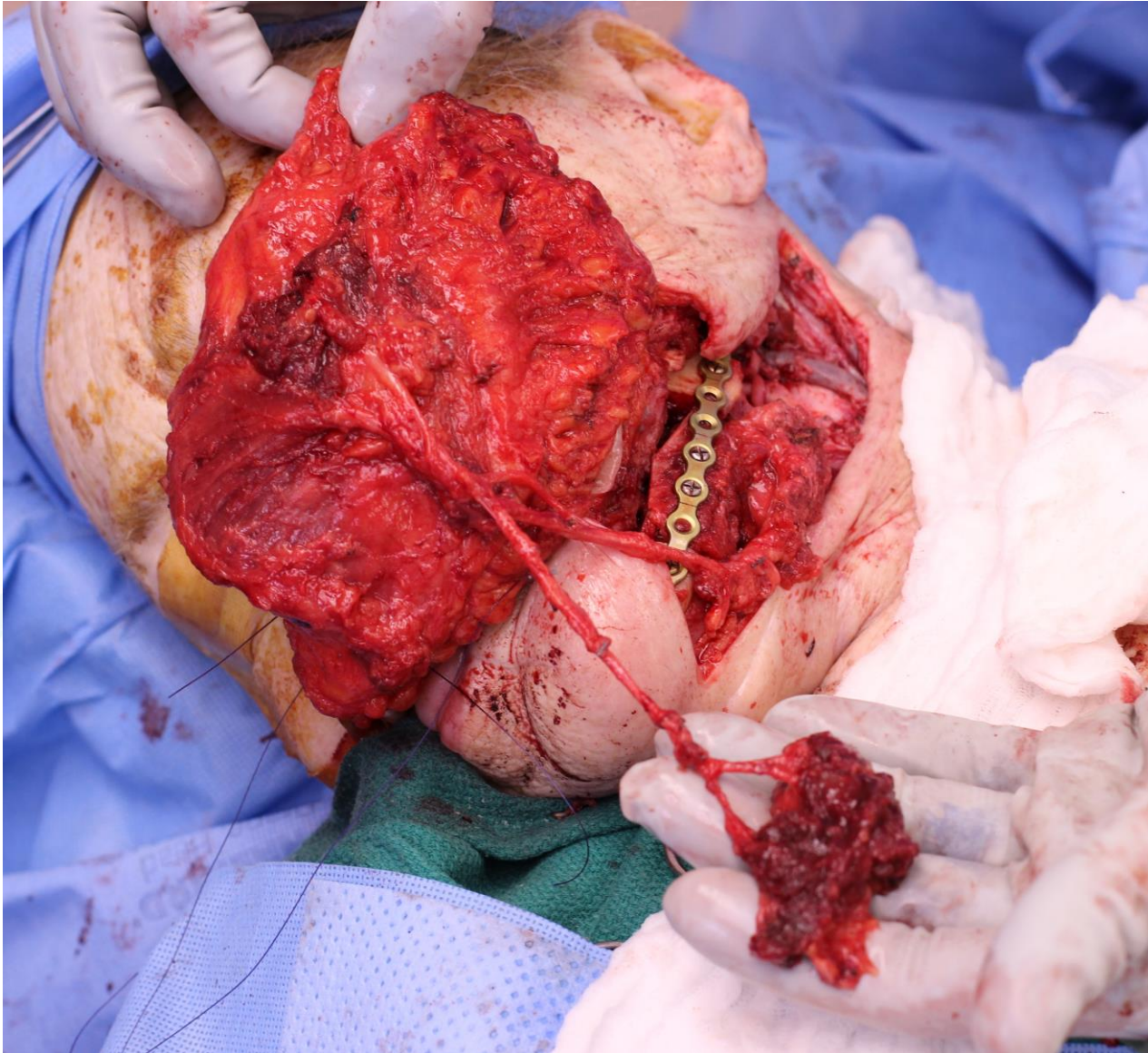
- Pathology: ORN
- Defect: mandible, neck skin
- Reconstruction: scapula, serratus, and latissimus dorsi osteomyocutaneous free flap



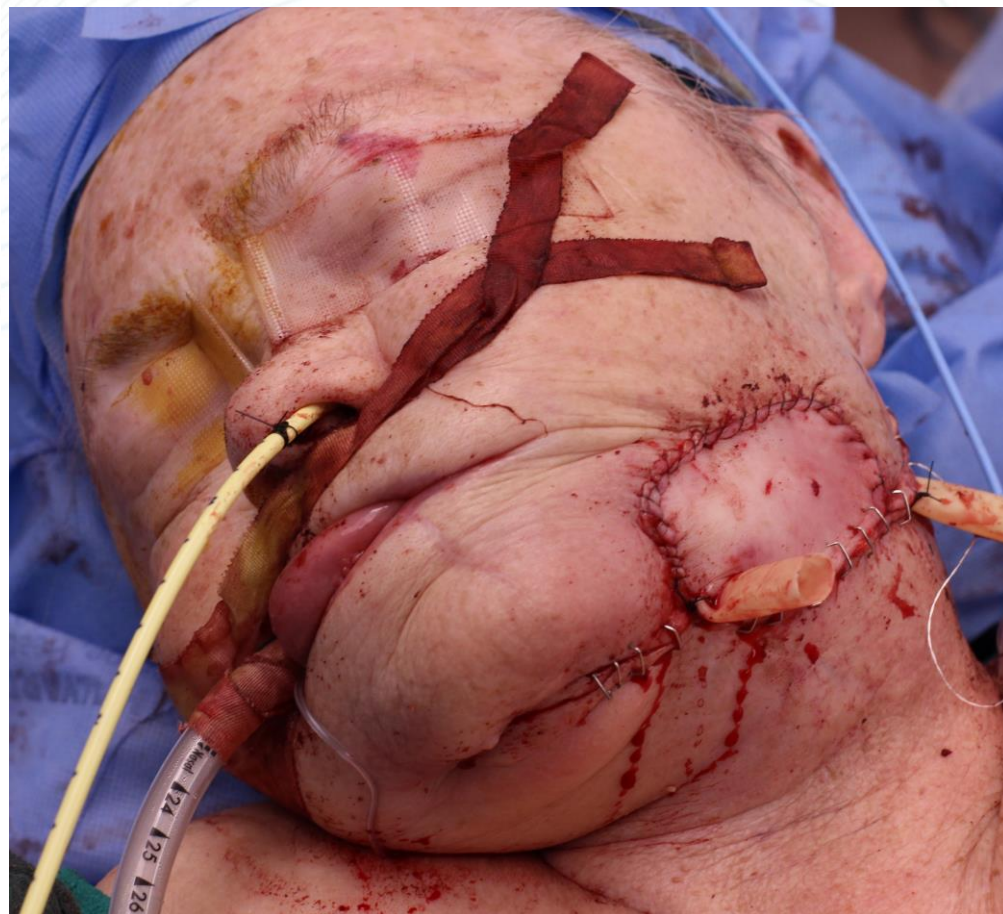
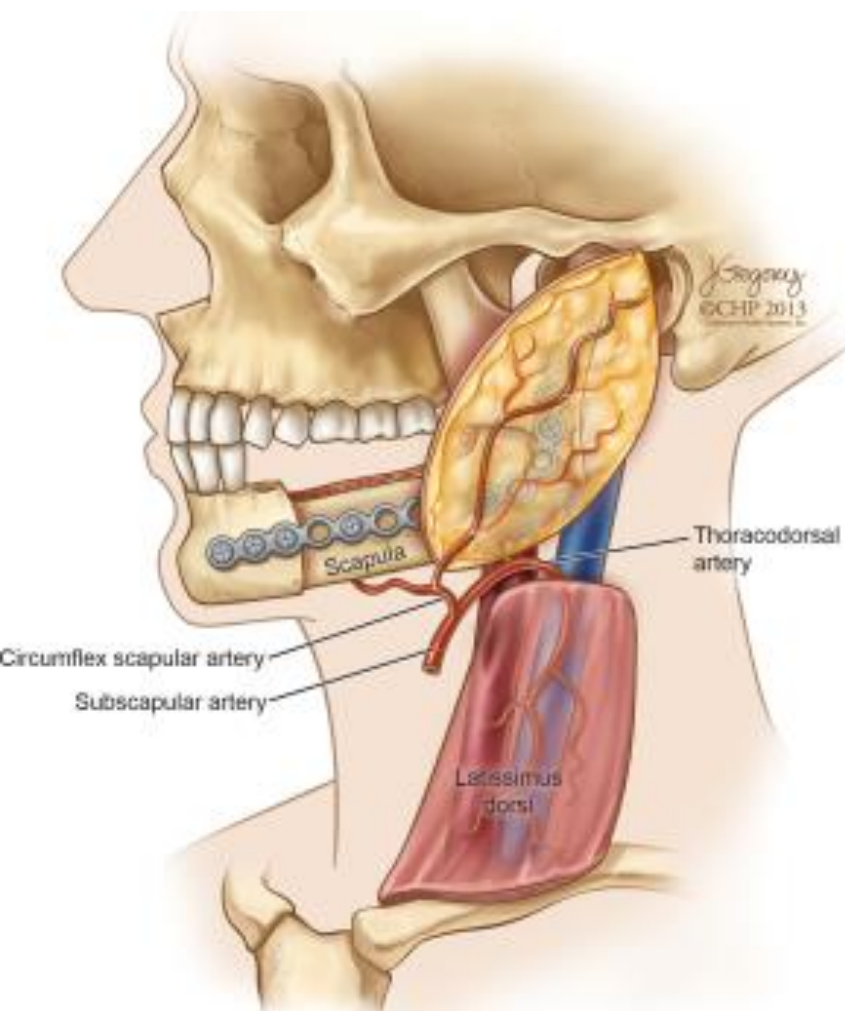








## Flap Planning





## Literature Review

# The relative survival of composite free flaps in head and neck reconstruction

*International Journal of  
Oral &  
Maxillofacial  
Surgery*

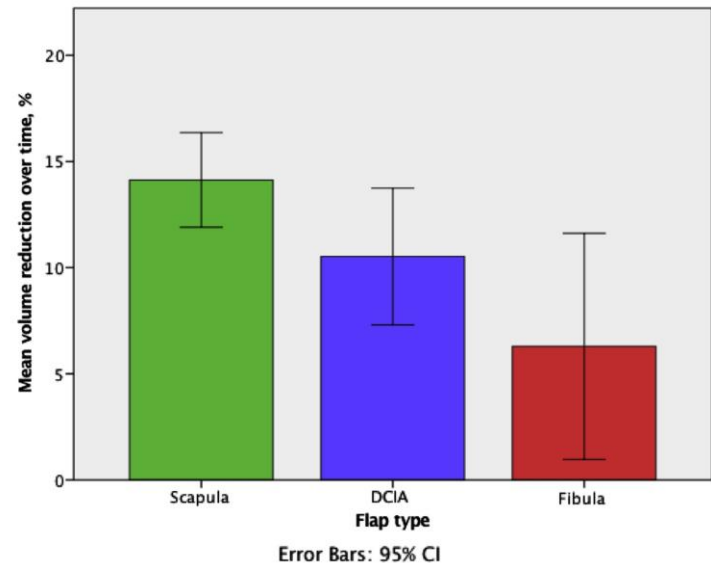
- Retrospective review of 173 bony free flaps for H&N recon
- 84 fibula, 43 iliac crest, 32 scapula, 14 forearm
- No failure of bony segments
- 3 lost fibula skin paddles
- No return to OR for salvage in any group
- No difference in survival rate

## Literature Review

# A Comparison of Bone Resorption Over Time: An Analysis of the Free Scapular, Iliac Crest, and Fibular Microvascular Flaps in Mandibular Reconstruction

*Tommy Wilkman, MD, DDS, \*Satu Apajalahti, DDS, PhD, †Erika Wilkman, MD, DDS, PhD, ‡Jyrki Törnwall, MD, DDS, PhD, § and Patrik Lassus, MD, PhD||*

- Retrospective review of 38 osseous free flaps from mandibular recon
- Followed with serial CT with volume analysis of bone
- 8 fibula, 25 iliac crest, 5 scapula
- Volume loss at 2 yrs: 14% scapula, 3% iliac crest, 1% fibula
- No clinical difference





## Literature Review



### A comparison of perioperative complications following transfer of fibular and scapular flaps for immediate mandibular reconstruction

Masahide Fujiki <sup>a,\*</sup>, Shimpei Miyamoto <sup>b</sup>, Minoru Sakuraba <sup>a</sup>,  
Shogo Nagamatsu <sup>a</sup>, Ryuichi Hayashi <sup>c</sup>

- 56 pts s/p segmental mandibulectomy
  - 18 scapula; 38 fibula
- All scapula sites closed primarily; all fibula site req STSG
- Operative time shorter with fibula (9h v 10h; p=.02)
- No difference in LOS, systemic and recipient site complications
  - Partial flap loss, infection, fistula lower in scap but not significant
- Overall donor site complications higher in fibula group (p=.01)
  - All a/w wound healing; 2 cases of seroma in scapula
- Suggests fibula delays ambulation in the elderly

# Literature Review

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**ORIGINAL ARTICLE**

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## Comparison of Fibular and Scapular Osseous Free Flaps for Oromandibular Reconstruction

### *A Patient-Centered Approach to Flap Selection*

Samuel A. Dowthwaite, MBBS; Julie Theurer, PhD; Mathieu Belzile, MD; Kevin Fung, MD;  
Jason Franklin, MD; Anthony Nichols, MD; John Yoo, MD

- 113 flaps: 58 fibular; 55 subscapular system
- 27(49%) STFF; 28 LSBF
- No significant difference in flap loss, nonunion/malunion, donor site complications
- Most frequent donor site complication in scapula flap was seroma; in fibula was wound breakdown
- Op time: LSBF >1 hr longer than fibula and STFF (p=.03)



## Literature Review

### Functional Donor Site Morbidity Following Latissimus Dorsi Muscle Flap Transfer

*William P. Adams, Jr, MD,\* Avron H. Lipschitz, MD,\* Mona Ansari, MD,† Jeffrey M. Kenkel, MD,\*  
and Rod J. Rohrich, MD\**

- Pt reported survey of 36 latissimus flaps followed 34 months
- 13 (38%) reported mild weakness; 8 (24%) reported moderate weakness
- Most reported difficulties with ADLs were reaching overhead, shoveling, and lifting
- 50% reported persistent numbness at donor site beyond 2 years

# Literature Review

## ORIGINAL ARTICLE

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### Functional Donor-Site Morbidity Following (Osteo-) Fasciocutaneous Parascapular Flap Transfer

*Christina Roll, MD, PhD,\* Lukas Prantl, MD,† Dominik Feser, MD,† Michael Nerlich, MD, PhD,\* and Bernd Kinner, MD, PhD‡*

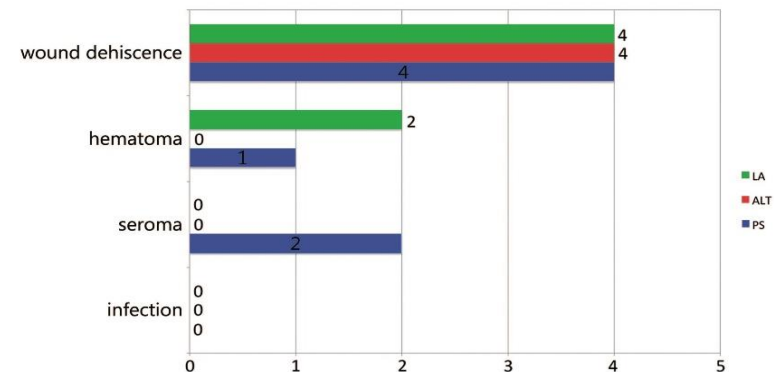
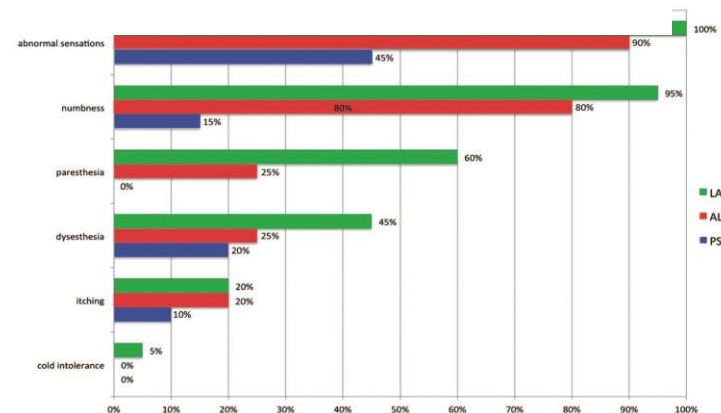
- 20 free osteocutaneous parascapular flaps performed by a single surgeon followed 3 years
- No perioperative flap loss, seromas
- Subjectively, 3/20 pts w/ limited shoulder ROM that limited ADLs
- Objectively, Constant-Murley not significantly different from age-match reference cohort



## Literature Review

### Comparison of Anterolateral Thigh, Lateral Arm, and Parascapular Free Flaps with Regard to Donor-Site Morbidity and Aesthetic and Functional Outcomes

- 60 fasciocutaneous flaps: 20 parascapular; 20 lateral arm; 20 ALT
- Results
  - No significant difference upper extremity ROM
  - No significant difference in post-op complications rate
    - 2/20 PS flaps had seroma
  - Highest pt satisfaction with PS flap
    - 100% would choose again (vs 85 for LA, 70% for ALT)



## Conclusions

- Multiple osseous and soft tissue components
- Single pedicle with long length and robust caliber
- Large volume
- Three dimensional flexibility
- Reliability
- Minimal morbidity
- High patient satisfaction



# Thank you!

- Questions?
- Special thanks to
  - Dr. David Reiter
  - Dr. Adam Luginbuhl
  - Dr. Joseph Curry
  - Dr. Howard Krein
  - Dr. Ryan Heffelfinger
  - Dr. John Gleysteen

